SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 18
SEPTEMBER 15, 1970

W70-07149 -- W70-07648

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

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For primary bibliographic entry see Field 02K.
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FREEZING TEMPERATURES OF WATER DROPLETS IN EQUILIBRIUM WITH DIFFERENT GASES,
Pennsylvania State Univ., University Park, Pa. Dept. of Meteorology.
For primary bibliographic entry see Field 02B.
W70-07335

02. WATER CYCLE

2A. General

MATHEMATICAL MODELS OF AREA RAINFALL,
State Rivers and Water Supply Commission, Melbourne (Australia).
For primary bibliographic entry see Field 02B.
W70-07175

FLOOD-WAVE FORMATION,
University Coll., Galway (Ireland); and State Rivers and Water Supply Commission, Melbourne (Australia).
J. E. Nash, and J. V. Sutcliffe.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 147-155, 1969. 9 p, 4 fig, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Flood forecasting, Evapotranspiration, Infiltration, Antecedent precipitation, Evaporation, Precipitation excess, Water storage, Optimization, Systems analysis, Probability, Streamflow forecasting.
Identifiers: Flood wave formation.

A mathematical rainfall-runoff model assumes that the catchment, in determining volumes of runoff due to individual rainfall events, is analogous to a vertical stack of horizontal soil layers each of which can contain a certain amount of water at field capacity. Evaporation from the top layer occurs at the potential rate and from the second layer only on exhaustion of the first and then at the potential rate multiplied by a parameter c the value of which is less than unity. On exhaustion of the second layer, evaporation from the third layer occurs at the potential rate multiplied by c squared, and so on. In this way a constant evaporation potential applied to the catchment would reduce the soil-moisture storage in a roughly exponential manner. When the rainfall exceeds the evaporation, a fraction of the excess contributes to generated runoff (output), and of the remainder anything in excess of a threshold value also contributes to generated runoff. The remaining rainfall excess is used in restoring the storages in the several layers to field capacity, beginning with the first and proceeding downwards until the rainfall excess is exhausted or all the layers are at field capacity. Any final excess also contributes to generated runoff. Other models are briefly reviewed. (Knapp-USGS)
W70-07179

MATHEMATICAL MODELLING OF THE RUNOFF PROCESS OF RIVERS WITH COMPOUND ALIMENTATION,
J. M. Denisov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 172-180, 1969. 9 p, 4 fig, 2 ref.

Descriptors: *Streamflow forecasting, *Mathematical models, Snowmelt, Routing, Synthetic hydrology, Simulation analysis, Rainfall-runoff relationships, Computer programs, Model studies, Flood forecasting.
Identifiers: *USSR.

Mathematical models used for runoff forecasting in the USSR are reviewed. The elaboration of mathematical models of river runoff has difficulties including lack of basic data, a considerable noise level, and the uncertainty of the characteristics of water movement in the drainage basin, its depth, and the circumstances of its emergence on to the surface, as well as its routing through the channel. The lack of basic data and the noise-level might cause a model which is theoretically more exact to appear less satisfactory than a rougher one. Modelling should therefore start with simpler schemes. The simplest model of snowmelt runoff on the surface of a mountain drainage basin and some subsequent transformation schemes are described. Weather station observations of daily air temperature, humidity and amount of precipitation serve as basic data for the runoff computation. The observations of from two to five stations situated in or near the catchment are usually enough. (Knapp-USGS)
W70-07182

MATHEMATICAL MODELING OF SNOW COVER FORMATION AND COMPUTATION OF THE SUPPLY OF WATER TO THE SURFACE OF A MOUNTAIN BASIN,
For primary bibliographic entry see Field 02C.
W70-07210

AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
George M. Hornberger, Janet Ebert, and Irwin Remson.
Typescript, 1969. 22 p, 10 fig, 24 ref. NSF Grant 4525.

Descriptors: *Numerical analysis, *Linear programming, *Groundwater movement, *Flow, *Aquifers, *Streams, Boundaries (Surfaces), Floods.
Identifiers: *Boussinesq equation, Werner-Sundquist model.

An efficient numerical technique was used to obtain solutions of the Boussinesq equation for problems of groundwater recession and groundwater flow in response to changes in stream stage. Comparison of the numerical results with the analytical solution of Boussinesque attested to the accuracy of the former. The solution of the recession problem indicated that the form of the Werner-Sundquist model of groundwater-discharge recession was appropriate. The solution of the problem involving changing boundary conditions on an aquifer due to a flood wave provided data relative to groundwater outflow. Comparison with the results of Cooper and Rorabaugh evaluated the applicability of a linear model of unconfined flow. (Kriss-Cornell)
W70-07232

THERMAL REGIME OF CRIMEAN RIVERS AND INFLUENCE ON IT OF KARST WATER FEEDING,
Ukrainskii Nauchno-Issledovatelskii Gidrometeorologicheskii Institut, Kiev (USSR).
A. V. Plashchev.
Transl. of Trudy Vkrain. Gidrometeorol. Instituta No. 60, 1966. p 97-106. Soviet Hydrology: Selected Papers 1966, No. 2, p 182-189.

Descriptors: *Thermal properties, *Temperature, Geothermal studies, Heat transfer, Heat flow, Streams, Karst, Rivers, Water temperature, Air temperature, Hydrology, Seasonal.

The thermal characteristics of Crimean rivers are examined in relation to their feeding by karst waters on the basis of observational data. Information is obtained on water temperature variations along a river and with elevation, on the difference of water temperature in the main river and tributaries, and on the dates of its transitions through certain gradation. Rivers of the Crimean Mountains have positive water, tw, and air, ta, temperature differences in cold period of the year and negative differences in the warm period. The tw/ta ratio depends on the distance of the river reach from the source of karst water supply. The tw/ta ratios for different Crimean rivers are presented. The study proved that the thermal regime of Crimean rivers, particularly in the upper and partly in the middle reaches, is determined by karst water feeding. (Novotny-Vanderbilt)
W70-07323

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

CONJUNCTIVE USE SYSTEMS ANALYSIS,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-07328

A RAINFALL-RUNOFF SIMULATION MODEL FOR ESTIMATION OF FLOOD PEAKS FOR SMALL DRAINAGE BASINS--A PROGRESS REPORT,
Geological Survey, Fort Collins, Colo., and Geological Survey, Menlo Park, Calif.
David R. Dawdy, Robert W. Litchty, and James M. Bergmann.
U S Geological Survey Open-file Report, 1970. 102 p, 15 fig, 12 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Simulation analysis, *Mathematical models, Optimization, Parametric hydrology, Flood forecasting, Streamflow forecasting, Infiltration, Streamflow, Runoff, Runoff forecasting, Rain gages, Digital computers, Data collections, Computer programs, Model studies, Systems analysis.
Identifiers: Rainfall-runoff models.

A parametric rainfall-runoff simulation model is used with data of a point rainfall gage and daily potential evapotranspiration to predict flood volume and peak rates of runoff for small drainage areas. The model is based on bulk-parameter approximations to the physical laws governing infiltration, soil moisture accretion and depletion, and surface streamflow. Three case studies are presented in which an objective fitting method is used for determining optimal best-fit sets of parameter values for the data available for use in predicting flood peaks. Errors of prediction result from both errors of rainfall input and lack of model equivalence to the physical prototype. These two sources of error seem to be of the same order of magnitude for a model of the level of simplicity of that presented. Major gains in accuracy of simulation will require improvements in both data and model. The limit of accuracy of prediction of flood peaks by simulation with a bulk-parameter model using a single rain gage seems to be on the order of 25 percent. (Knapp-USGS)
W70-07365

SNOWMELT SIMULATION,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02C.
W70-07536

2B. Precipitation

MATHEMATICAL MODELS OF AREA RAINFALL,
State Rivers and Water Supply Commission, Melbourne (Australia).
G. N. Alexander.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 81-100, 1969. 20 p, 5 fig, 1 tab, 12 ref.

Descriptors: *Flood forecasting, *Mathematical models, *Statistical models, *Rainfall disposition, *Distribution patterns, Depth-area-duration analysis, Duration curves, Hydrographs, Hyetographs, Streamflow forecasting, Runoff forecasting, Probability.
Identifiers: Area rainfall models.

The use of mathematical models of area rainfall in flood forecasting is discussed. Both deterministic and probabilistic models may be used, depending on conditions and the climatic records available. Only by study of rainfall in three dimensions, that is in depth and over areas, will a unifying treatment of rainfall distribution suitable for use in flood estimation be obtained. It is necessary to eliminate some misconceptions and then postulate models that can be tested with the large volume of rainfall data available. The spatial models discussed should assist in estimating flood magnitudes from rainfall. (Knapp-USGS)
W70-07175

PROBABLE MAXIMUM AND TVA PRECIPITATION FOR TENNESSEE RIVER BASINS UP TO 3,000 SQUARE MILES IN AREA AND DURATIONS TO 72 HOURS,
Weather Bureau, Silver Spring, Md. Office of Hydrology.
Francis K. Schwarz, and Norbert F. Helfert.
U S Weather Bureau Hydrometeorological Report No 45, May 1969. 166 p, 91 fig, 26 tab, 33 ref. Tenn Valley Authority, Contract TV-23942A.

Descriptors: *Probable maximum precipitation, *Antecedent precipitation, *Tennessee Valley Authority Project, Hydrology, Meteorology, Estimating, Rainfall disposition, Flood forecasting, Runoff forecasting, Streamflow forecasting.
Identifiers: Tennessee Valley.

Generalized estimates are given of 1- to 72-hr precipitation extremes for basins in the TVA region ranging in size from a few square miles to about 3000 square miles. Antecedent rainfall criteria are provided also for use as indices to soil moisture conditions and existing streamflows at the beginning of the critical rainfalls. (Knapp-USGS)
W70-07195

FACTORS FORMING THE CHEMICAL COMPOSITION OF PRECIPITATION,
Politekhnicheskii Institut, Novocherkassk (USSR).
For primary bibliographic entry see Field 02K.
W70-07206

METEOROLOGICAL TABLES FOR DETERMINATION OF PRECIPITABLE WATER, TEMPERATURES, PRESSURES ALOFT FOR A SATURATED PSEUDOADIABATIC ATMOSPHERE - IN THE METRIC SYSTEM,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 07C.
W70-07228

FREEZING TEMPERATURES OF WATER DROPLETS IN EQUILIBRIUM WITH DIFFERENT GASES,
Pennsylvania State Univ., University Park, Pa. Dept. of Meteorology.
Jorge Pena, and Rosa G. de Pena.
Journal of Geophysical Research, Vol 75, No 15, p 2831-2835, May 20, 1970. 5 p, 3 fig, 2 tab, 10 ref. NSF Grant GA 3956.

Descriptors: *Freezing, *Water vapor, *Clouds, *Supercooling, *Clathrates, Hydrate processes, Hydrates, Carbon dioxide, Argon, Methane, Atmosphere, Cloud physics, Precipitation (Atmospheric), Water chemistry, Water properties, Thermodynamics.
Identifiers: Clathrate thermodynamics, Sulfur dioxide.

Many gases react with water at low temperature to form hydrates called clathrates. Among the atmospheric gases, carbon dioxide, argon, methane, and sulfur dioxide behave in this way. The influence of gases forming clathrates at the freezing temperature of water droplets was investigated to study the possible influence of the clathrates on the freezing of cloud droplets. Gases with very low solubility in water have no effect or a very small one. Gases having higher solubilities increase the supercooling, but the increase is greater than the lowering of the freezing point expected because of dissolved gas. The clathrate structure has an inhibiting effect on the freezing of supercooled water droplets. This inhibiting effect should not have a detectable influence on the freezing of cloud droplets because of the low concentration of these gases in the atmosphere. (Knapp-USGS)
W70-07335

INTERNATIONAL SYMPOSIUM ON ATMOSPHERIC TRACE CONSTITUENTS AND ATMOSPHERIC CIRCULATION.

Journal of Geophysical Research, Vol 75, No 15, p 2875, May 20, 1970. 1 p.

Descriptors: *Conferences, *Trace elements, *Atmosphere, *Air circulation, Tracers, Fallout, Atmospheric physics, Cloud physics, Air masses, Precipitation (Atmospheric), Tritium, Deuterium, Radioisotopes, Stable isotopes, Water chemistry.
Identifiers: Atmospheric trace elements.

A Symposium on Atmospheric Trace Constituents and Atmospheric Circulation was held in Heidelberg, Germany, September 8-13, 1969. The symposium was sponsored jointly by the World Meteorological Organization and IAMAP. The University of Heidelberg was host organization. More than 100 scientific papers were presented in symposium sessions on the following topics: Tracers and Transport Processes; Radioactive Aerosol Transport and Fallout; Radiocarbon and Tritium Distribution; Aerosol Formation and Removal Processes; Atmospheric Trace Gas Distribution; Aerosol Distribution and Composition; Upper Atmosphere Constituents; Atmospheric Geochemistry; Emanations and Daughters as Tracers; Air and Precipitation Chemistry; and Cosmogenic Radiosotopes as Tracers. (Knapp-USGS)
W70-07336

APPLICATION OF SHORT-LIVED COSMOGENIC RADIONUCLIDES AS TRACERS OF IN-CLOUD SCAVENGING PROCESSES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. W. Perkins, C. W. Thomas, and J. A. Young.
Journal of Geophysical Research, Vol 75, No 15, p 3076-3087, May 20, 1970. 12 p, 10 fig, 1 tab, 11 ref. AEC Contract AT (45-1)-1830.

Descriptors: *Radioisotopes, *Trace elements, *Tracers, *Atmosphere, *Precipitation (Atmospheric), Atmospheric physics, Rainfall, Cloud physics, Sampling, Instrumentation, Fallout.
Identifiers: Cosmogenic radionuclides.

Measurements of the cosmogenic radionuclides C1-38 (37.3 min half-life), C1-39 (55 min), and Na-24 (15 hours) in consecutive rain water samples during storms provide a basis for studying precipitation formation processes. These radionuclides, which result from cosmic-ray spallation of atmospheric argon, 'label' the natural aerosols, and can thus serve as tracers of in-cloud scavenging. Rain collected on a polyethylene sheet is continuously passed through ion exchange beds which retain the radionuclides. Subsequent direct counting of the beds by selective coincidence counting techniques allows their direct measurement. Analysis of rain samples collected over consecutive periods as short as 10 min has established several basic relationships from which the rates and possible mechanisms of various in-cloud precipitation formation and scavenging process are determined. (Knapp-USGS)
W70-07337

TRACE ELEMENT CONCENTRATIONS IN THE TROPOSPHERE AND LOWER STRATOSPHERE.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 02K.
W70-07338

EVOLUTION OF THE ISOTOPIC COMPOSITION OF ATMOSPHERIC WATERS IN THE MEDITERRANEAN SEA AREA,
Weizmann Inst. of Science, Rehovot (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 02K.
W70-07339

THE SEASONAL VARIATION IN THE CONCENTRATION OF STRONTIUM 90 IN RAIN AND ITS DEPENDENCE ON LATITUDE,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
For primary bibliographic entry see Field 05B.
W70-07340

DAILY VARIATIONS IN THE TRITIUM CONCENTRATION OF ATMOSPHERIC MOISTURE,
Gakushuin Univ., Tokyo (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 05B.
W70-07341

MECHANISMS OF TRANSPORT FROM THE ATMOSPHERE TO THE EARTH'S SURFACE,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
U. Moller, and G. Schumann.
Journal of Geophysical Research, Vol 75, No 15, p 3013-3019, May 20, 1970. 7 p, 5 fig, 18 ref.

Descriptors: *Mass transport, *Fallout, *Air-water interfaces, *Diffusivity, *Path of pollutants, Precipitation (Atmospheric), Trace elements, Laboratory tests, Winds, Water pollution sources, Sea water, Sampling, Tracers, Tracking techniques, Diffusion.
Identifiers: Wind tunnels.

Wind-tunnel experiments were made with wind speeds of 3 through 8 m/sec to study deposition of particles and gases on a water surface. The deposition velocity was measured for water vapor, carbon dioxide, atomic lead, purified-water residual nuclei, sodium chloride aerosols, and polystyrene latex spheres. Radioactive tracers were used for detection. The studies covered diffusion coefficients from 10 to the -7 power to 0.25 sq cm/sec, with all tests carried out under the same conditions. The results are best fitted by a relation in which velocity varies as the 2/3 power of the diffusion coefficient in the range 0.02 to 0.00002 thus favoring the concept of proportionality between the characteristic length in the turbulent boundary layer and the height above the surface. (Knapp-USGS)

W70-07342

METEOROLOGICAL RECORDS FOR LAKESIDE, 1968 AND 1969.
State Univ. Coll., Fredonia, N.Y.
RICHARD Carroll, and John A. Jones.
New York State University, Fredonia, Technical Data Report No 6, Lake Erie Environmental Studies, May 1970. 28 p, 3 fig, 2 ref, append.

Descriptors: *Climatic data, *Lake Erie, *New York, *Data collections, Climatology, Weather data, Temperature, Humidity, Winds, Solar radiation.
Identifiers: Lakeside laboratory (NY).

Reduced meteorological data are summarized for the latter half of 1968 and all of 1969 at the Lakeside Laboratory of Lake Erie Environmental Studies. The Lakeside Laboratory is located on the southeastern shore of Lake Erie. The laboratory is on a bluff 9 meters above lake level and about 100 meters from the shoreline behind a line of trees averaging about 15 meters high. The recording instruments include a thermograph, a hygrometer, an anemometer, a pyrheliograph, a rain and snow gage, and microbarograph. The period was selected for the availability of continuous records on the widest variety of instruments and the completeness of these records. Gaps in the records reflecting periods of instrument failure, are few. On the whole, the reporting period may be described as relatively typical for the region. Total precipitation for both years was quite close to normal. winter temperatures were atypically mild. Wind and pressure regimes are probably typical. (Knapp-USGS)
W70-07345

INTERNATIONAL GLOSSARY OF HYDROLOGY - SECOND DRAFT (JULY 1969).
For primary bibliographic entry see Field 10.
W70-07403

WESTERN SNOW CONFERENCE.

Proceedings available for sale by Western Snow Conference, Robert T. Davis, Secretary, Room 360, US Courthouse, Spokane, Wash, 99201. Proceedings 37th Annual Meeting of Western Snow Conference, April 15-17, 1969, Salt Lake City, Utah; printed by Colorado State University, Fort Collins, 1969. 110 p.

Descriptors: *Conferences, *Snow, *Snow surveys, *River forecasting, Water supply, Instrumentation, Social impact, Freezing, Melting, Telemetry, Evaporation, Sublimation, Water equivalent, Simulation analysis, Cloud seeding, Economics, Forecasting, Planning.
Identifiers: Western Snow Conference.

The 37th annual Western Snow Conference, Salt Lake City, 1969, includes papers on evaporation, sublimation, water content, runoff, soil water freezing, remote sensing, instrumentation, simulation of snowmelt, snow structure, cloud seeding, forecasting, and social and economic aspects of forecasting. Each paper includes an abstract, subject, and author index. The minutes and attendance list of the meeting are also included. (See also W70-07531 thru W70-07542 and W70-07676 thru W70-07678). (Knapp-USGS)
W70-07530

COMPUTER DETERMINATION OF CLOUD SEEDING AREA OF EFFECT,
North American Weather Consultants, Goleta, Calif.
For primary bibliographic entry see Field 03B.
W70-07538

AIRBORNE SEEDING TECHNIQUES APPLIED TO WINTER OROGRAPHIC CLOUDS,
EG and G, Inc., Boulder, Colo. Environmental Services Operation.
For primary bibliographic entry see Field 03B.

W70-07539

2C. Snow, Ice, and Frost

PLAN AND PROFILE CHARACTERISTICS OF BEACHES IN THE CANADIAN ARCTIC ARCHIPELAGO,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
S. B. McCann, and E. H. Owens.
Shore and Beach, Vol 38, No 2, p 26-30, April 1970. 5 p, 4 fig, 8 ref.

Descriptors: *Beaches, *Cold regions, Erosion, Sediment transport, Deposition (Sediments), Beach erosion, Waves (Water), Sea ice, Ocean waves, Tidal effects, Surf.
Identifiers: Canadian Arctic Archipelago.

A reconnaissance of beaches in the Southern Queen Elizabeth Islands in the Canadian Arctic Archipelago during 1967 led to the selection of two sites, at Cape Ricketts and Beechy Island, on southwest Devon Island, which were used for detailed field investigations of the physical and dynamic properties of the beach zone, using the same sedimentological and surveying techniques normally used in studies of lower latitude shorelines. Meteorological data is available from the weather station at Resolute, 105 km to the west of Cape Ricketts. The adjacent sea areas are flown regularly by ice patrols so that records of the distribution and movement of the sea ice cover are readily available. The many similarities of form between the beaches and southwest Devon and those of non-Arctic areas attests to the fact that the same littoral processes, in terms of wave and current action, operate in this region as elsewhere in the world. Normal methods of investigation and measurement are applicable in this area and provide information which may be compared with data from studies in other environments. The role of ice, largely as a negative factor in preventing wave generation at sea and wave action on the beach, does not cause any very significant changes in beach plan or profile. (Knapp-USGS)
W70-07152

SNOWFIELD MAPPING WITH K-BAND RADAR,
Kansas Univ., Lawrence. Remote Sensing Lab.
For primary bibliographic entry see Field 07B.
W70-07157

METHOD OF COMPUTING THE DYNAMICS AND YIELD OF SNOW WATER,
G. Ye. Glazyrin, and P. K. Lifanov.
Transl. from Trudy SANIGMI, No 39 (5), p 24-29, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 615-620, 1968. 1 fig, 10 ref.

Descriptors: *Water yield, *Snowmelt, *Snow cover, Rivers, Heat flow, Equations, Mountains, Snow management, Runoff, Snowpacks, Runoff forecasting.
Identifiers: *USSR.

Snow melting and the water yield from snow cover are the main factors determining the hydrologic regimes of the majority of mountain and lowland rivers. The water yield intensity is proportional to melting intensity. The regulating effect of snow layers can not be neglected if the daily runoff pattern from the snow cover must be know. If a more accurate account of the change in the water content of a snow layer is needed, then information on the internal structure of the snow cover at the beginning of the period for which the computations are made is needed. In this case the heat flux in the snow layer and its derivative in the respect to depth are also necessary. A system of equations is given for these calculations. (Carstea-USGS)
W70-07207

MATHEMATICAL MODELING OF SNOW COVER FORMATION AND COMPUTATION OF THE SUPPLY OF WATER TO THE SURFACE OF A MOUNTAIN BASIN,
L. N. Borovikova.
Transl. from Trudy SANIGMI, No 39 (5), p 37-43, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 620-625, 1968. 3 fig, 1 tab, 5 ref.

Descriptors: *Mathematical models, *Model studies, *Snow cover, *Snowmelt, *Water supply, Water yield, Basins, Rivers, Glaciers, Gaging stations, Snow surveys, Rain water.
Identifiers: *USSR, Akhangaran River, Alarcha River, Malaya Almaatinka River.

A mathematical model of snowmelt-runoff relations takes into consideration the variation of air temperature with time and refines the melting coefficients. The scheme for computing the supply of water to a basin surface also allows for meltwater derived from glaciers. Computations of water supply from snow cover were made for the Akhangaran River basin, and the Alaarcha and Malaya Almaatinka Rivers, USSR. Good agreement was found between the computed distribution of the amount of water in snow with elevation and that measured at snow gaging stations during snow surveys. The total inflow to the basin is the sum of 3 components: inflow of melt, rain water, and water from the melting of glaciers. Examples of computations are given. (Carstea-USGS)
W70-07210

NOTE ON SOME VERTICAL PROFILES BELOW ICE FLOES IN THE GULF OF ST. LAWRENCE AND NEAR THE NORTH POLE,
McGill University, Montreal (Quebec). Marine Sciences Centre.
Ola M. Johannessen.
Journal of Geophysical Research, Vol 75, No 15, p 2857-2861, May 20, 1970. 5 p, 3 fig, 1 tab, 9 ref. National Research Council of Canada, Grant T-2645.

Descriptors: *Currents (Water), Sea ice, *Roughness (Hydraulic), *Flow profiles, Flow measurement, Current meters, Profiles, Hydraulics, Aquatic drift, Drifting (Aquatic).
Identifiers: Sea ice floes.

The vertical current-velocity profile method was used to estimate the roughness parameter for the lower surface of different ice floes. The roughness parameter varied from 0.2 cm for smooth arctic ice to 10 cm for rough ice in the Gulf of St. Lawrence. The thickness of the boundary layer under smooth arctic ice is estimated to 1 meter and for the ice in the Gulf of St. Lawrence to 0.6 meter or less. (Knapp-USGS)
W70-07353

A POSSIBLE RELATION BETWEEN GRAIN SIZE, DENSITY, AND LIGHT ATTENUATION IN NATURAL SNOW COVER,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
James D. Bergen.
J Glaciology Vol 9, No 55, p 154-156, 1970.

Descriptors: *Snow, *Light penetration, *Optical properties, Snow cover, Snowpack, Light, Opacity, Radiation, Physics, Solar radiation.
Identifiers: *Snow cover opacity.

The extinction coefficient for the transmission of light through snow cover is related to the grain size and density of the snow cover. The connection is made by means of an empirical relation between the latter parameters and the air permeability and by the Carmen-Kozney relation between the air permeability and specific surface of a porous medium. The results are compared with a set of measurements found in the literature with fair agreement between the predicted and measured values of the extinction coefficient. (Bergen-Forest Service)
W70-07514

THE CLASSIFICATION OF SNOW METAMORPHISM,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
R. A. Sommerfeld, and E. LaChapelle.
Journal of Glaciology, Vol 9, No 55, p 3-17, 1970.

Descriptors: *Snow cover, *Snowpacks, *Avalanches, Firm, Crystals, Snowmelt, Slopes, Colorado.
Identifiers: Depth hoar, Metamorphism (Snow).

A new classification of snow on the ground is based on the major physical processes involved in the metamorphism of a snow cover. The major divisions are based on (I) the mechanical damage to snow crystals during precipitation, (II) the transport of water vapor at constant temperature because of surface energy differences, (III) the transport of water vapor along a thermal gradient, and (IV) firnification because of melting and refreezing, and pressure consolidation.
W70-07516

SNOWPACK DENSITY, WATER CONTENT AND RUNOFF ON A SMALL ARIZONA WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
Peter F. Ffolliott, and David B. Thorud.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 12-18, 1969. 7 p, 7 fig, 3 tab, 16 ref.

Descriptors: *Snowpacks, *Melting, *Runoff forecasting, *Snowmelt, Water yield, Water supply, Heat balance, Snow management, Water management (Applied).
Identifiers: Snowpack ripening.

Snow density is one useful index of the stage of 'ripening' in a snowpack. Fresh snow often has a density of 0.10 gm per cc or less. As the snowpack undergoes metamorphosis and ripening a density of 0.35 to 0.50 gm per cc is attained. In Arizona the snowpack is usually 'ripe' in this range. Additional energy input to the snowpack will cause runoff. In field study of Arizona snowpacks, ripening was rapid. Six days after peak snowpack accumulation the number of sample points with a density of 0.37 gm per cc or greater increased from 1% to about 50%. However, at this time and for a considerable portion of the runoff period, 20% of the points had snow with a density of 0.30 gm per cc or less. This snow was probably not yielding melt water. The snowpack water content did not appear to be normally distributed. The coefficient of variation increased with time. Relationships between snowpack density, water content, timber stocking, elevation, and potential insolation were weak. (See also W70-07532). (Knapp-USGS)
W70-07531

SOIL-WATER FREEZING, SNOW ACCUMULATION AND ABLATION IN MARMOT CREEK EXPERIMENTAL WATERSHED, ALBERTA, CANADA,
Department of Fisheries and Forestry, Calgary (Alberta).
R. L. Harlan.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 29-33, 1969. 5 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Snowmelt, *Recharge, *Infiltration, *Runoff, *Surface-groundwater relationships, Water yield, Water supply, Demonstration watersheds, Ablation, Snow surveys, Rainfall-runoff relationships, Base flow.
Identifiers: Experimental watersheds.

A research program was initiated in the early 1960's to explore the interrelationships between vegetation, soil, climate, and water on the eastern slope of the Canadian Rocky Mountains. The relations between soil-water and soil-temperature conditions and snow accumulation and ablation, vegetation, and slope orientation were determined. Thawing of soil occurred both from above and and from below. In the 1966 and 1967 snowmelt periods, soil thawing occurred before snowpack ablation; whereas during 1965, the soil remained partly frozen until after complete disappearance of the snowpack. The snowpack was depleted most rapidly beneath immature lodgepole pine cover and was most persistent beneath uncut spruce-fir. Only a small percentage of the water in the snowpack entered soil-water storage during snowmelt. Hydrograph analysis showed that although moderate increases in streamflow do occur during snowmelt, these discharges are indicative of increased baseflow, not surface runoff. Since snowmelt appeared neither as soil-water recharge now as overland flow, it is implicit that snowmelt contributed directly to groundwater except when melt precedes thawing of the soil profiles or is lost to evaporation. (See also W70-07534). (Knapp-USGS)
W70-07533

SATELLITE PHOTOGRAPHY FOR SNOW SURVEILLANCE IN WESTERN MOUNTAINS,
Allied Research Associates, Inc., Concord, Mass.
For primary bibliographic entry see Field 07B.
W70-07534

HYDROLOGY OF SNOW PROFILES OBTAINED WITH THE PROFILING SNOW GAGE,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
James L. Smith, and Howard G. Halverson.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 41-48, 1969. 8 p, 8 fig, 1 tab, 2 ref.

Descriptors: *Snowpacks, *Nuclear moisture meters, *Water yield, Profiles, Snowmelt, Runoff forecasting, Water supply, Melt water, Instrumentation, Snow management, Snow surveys.
Identifiers: Snow moisture meters, Meltwater movement.

A profiling radioactive snow gage was developed at the Central Sierra Snow Laboratory. With the profiling snow gage one may profile a snowpack at a speed of one foot per minute. Density in percent and depth in feet to hundredths of feet are printed out for approximately each one-half inch interval throughout the pack. Accuracy of the system can be within one-half of one percent of absolute accuracy. The data are accurate to within 1.5 percent of true density. Following the development of the snow gage, daily and more frequent profiles have been collected from snowpacks during the winters of 1966-67, 1967-68, and 1968-69. From study of these profiles new data on water-holding capacities for snowpacks in various stages of metamorphism have been examined in the light of previous concepts. Liquid water is held in the pack in three forms: Hygroscopic water - or water absorbed onto the surface of the crystal and probably absorbed into the crystal; capillary water - or water held by surface tension in the capillary spaces; and gravitational water - that water which is in transit through the pack. (See also W70-07536). (Knapp-USGS)
W70-07535

SNOWMELT SIMULATION,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
J. Paul Riley, Duane G. Chadwick, and Keith O. Eggleston.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 49-56, 1969. 8 p, 8 fig, 10 ref.

Descriptors: *Snowmelt, *Mathematical models, *Simulation analysis, Model studies, Energy budget, Heat budget, Ablation, Evaporation, Solar radiation, Snow management, Temperature, Runoff forecasting, Streamflow forecasting.
Identifiers: Snowmelt simulation.

A preliminary mathematical model of the snowmelt process has been developed in which processes such as pack settlement rates and energy flow in the pack by means of both conduction and liquid movement are considered. Factors such as temperature, surface albedo, and degree and direction of slope are also included. A temperature criterion is applied to predict the form of precipitation input (snow or rain) to the model. Equations of the various processes are synthesized into a dynamic model of the total system by means of an electronic analog computer. Field data from snow laboratories operated by the Corps of Engineers and highly instrumented watersheds of the ARS are being used to test and verify the model. Initial results have indicated close agreement between observed and computed results. Sensitivity studies have been conducted, and work is continuing to further test and improved the model. (See also W70-07537). (Knapp-USGS)
W70-07536

COMPARISON OF GRAVIMETRIC MEASUREMENTS AND MASS TRANSFER COMPUTATIONS OF SNOW EVAPORATION BENEATH SELECTED VEGETATION CANOPIES,
Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.
Robert D. Doty, and Robert S. Johnston.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 57-62, 1969. 6 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Evaporation, *Snowpacks, *Vegetation effects, Instrumentation, Water management (Applied), Forecasting, Runoff forecasting, Water yield, Water supply, Snow management.
Identifiers: Snowpack evaporation.

Snow evaporation was studied at two sites at 7,000 feet elevation about 30 miles east of Logan, Utah. Both sites were located in the fairly level bottom of a U-shaped valley, with scattered aspen and conifer stands, with large openings. One site was an aspen stand with an average height of 60 ft and basal area of 91 sq ft per acre. The second site, one-quarter mile away, had a dense mixed conifer stand with an average hieght of 67 ft and basal area of 100 sq ft per acre. Evaporation on only one site was measured on any given day. Evaporation loss was measured gravimetrically from clear plastic evaporimeters. Meteorological instruments were a sheltered hygrothermograph and totalizing anemometer. Both were positioned one meter above the snow surface, and a pyrheliometer was located midway along and to the lee of each line of evaporimeters. Snow surface temperatures were measured with a Stoll-Hardy radiometer. All meteorological data were recorded at intervals of one hour. Evaporation was greatest in the open, intermediate in the aspen stand, and least under the conifer stand. The maximum evaporation in the open (0.076 gm/sq cm) and in the aspen (0.068 gm/sq cm) occurred on the same day in March when the highest average temperatures and wind speeds were recorded for both areas. The minimum evaporation was recorded in the aspen stand in January when the average temperature was 3.2 deg C, average wind was 6.2 cm/sec, and the average relative humidity was 82.4%. (See also W70-07538). (Knapp-USGS)
W70-07537

A 2-YEAR EVALUATION OF THE SNOWMELT LYSIMETER,
Forest Service, Moscow, Utah. Forestry Sciences Lab.
For primary bibliographic entry see Field 07B.
W70-07541

A SNOWPACK EVAPO-SUBLIMATION FORMULA,
Soil Conservation Service, Casper, Wyo. Snow Survey.
George W. Peak.

Proceeding 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 1-11, 1969. 11 p, 17 plate.

Descriptors: *Evaporation, *Snowpacks, Water management (Applied), Forecasting, Runoff forecasting, Streamflow forecasting, Water yield, Water supply, Snow management.
Identifiers: Snowpack evaporation.

Snowmelt-runoff equations are presented for watersheds with alpine areas, or open range at deep snowpack elevations. Factors are given to adjust for the variable and substantial evapo-sublimation losses. Radiation must be measured on a local basis. Forecasts can have good accuracy if alpine wind, temperature, insolation and humidity data are available. (See also W70-07530). (Knapp-USGS)
W70-07542

2D. Evaporation and Transpiration

COMPARISON OF GRAVIMETRIC MEASUREMENTS AND MASS TRANSFER COMPUTATIONS OF SNOW EVAPORATION BENEATH SELECTED VEGETATION CANOPIES,
Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02C.
W70-07537

A SNOWPACK EVAPO-SUBLIMATION FORMULA,
Soil Conservation Service, Casper, Wyo. Snow Survey.
For primary bibliographic entry see Field 02C.
W70-07542

2E. Streamflow and Runoff

RECONNAISSANCE OF THE PIGEON RIVER, A COLD-WATER RIVER IN THE NORTHCENTRAL PART OF MICHIGAN'S SOUTHERN PENINSULA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07166

HYDROGEOLOGY AND WATER QUALITY STUDIES IN THE CACHE LA POUDRE BASIN, LARIMER AND WELD COUNTIES, COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 05B.
W70-07167

THE MOVEMENT OF FLOOD-WAVES IN NATURAL CHANNELS AND SOME PROBLEMS OF RIVER DISCHARGE AND STAGE FORECASTING,
Hydrometeorological Service of the USSR (Moscow).
E. G. Popov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 14-24, 1969. 11 p, 3 fig, 17 ref.

Descriptors: *Flood forecasting, *Unsteady flow, *Equations, Mathematical studies, Estimating, Statistical methods, Computer programs, Digital computers, Reviews, Hydrograph analysis, Network design.
Identifiers: USSR, Saint-Venant equations.

The methods and techniques of short-range river discharge and stage forecasting based on the laws of water flow in channels and in particular on the laws of movement and transformation of flood-waves within limited river reaches are reviewed. The period of time which can be covered by such forecasts depends mainly on the wave speed and the length of river reaches. The complexity of unsteady flow in natural channels and the lack of data are the main causes for the approximate nature of the forecasting techniques used at present, the simplest of which have been known since the last century. Electronic computers make it possible nowadays to use more reliable hydrodynamic methods, but their application is limited in many cases by lack of data. For this reason approximate methods, based on current information, still retain their practical value. Unsteady flow in natural channels may be described by two differential equations in partial derivatives known as the Saint-Venant equations. The computation of unsteady flow is possible only by means of numerical integration of these equations. The most widespread method of numerical integration is the network method based on the replacement of partial derivatives by the finite difference ratios with consecutive solution of the system of algebraic equations. (Knapp-USGS)
W70-07172

THE ACQUISITION OF DATA FOR FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
D. N. Body.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 69-72, 1969. 4 p, 5 ref.

Descriptors: *Flood forecasting, *Network design, *Hydrologic data, *Data collections, Instrumentation, Data processing, Stream gages, Rain gages, Telemetry, Surveys, Data transmission, Remote sensing.
Identifiers: Data requirements.

In any operational flood-forecasting system the observation and transmission of the data upon which the forecasts are to be based are vital. With the development of improved techniques for the formulation of forecasts it is most likely that the requirement for data will be increased, both in terms of the number of elements to be observed and the frequency of observation. In most instances these requirements will be such as to preclude the use of voluntary part-time observers. These facts demonstrate the need to develop data-acquisition systems concurrently with improved techniques of flood forecasting. Such systems must be unaffected by severe weather conditions and should produce the data in a form suitable for direct treatment by computers. Because of the limited manpower which can usually be allocated to operational forecasting, data-acquisition systems should be designed to operate automatically whether they are based on observers or telemetering equipment. In this way the forecaster can concentrate on his major task, the formulation of the forecast. (Knapp-USGS)
W70-07173

SOME POTENTIAL APPLICATIONS OF METEOROLOGICAL SATELLITES IN FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 07B.
W70-07174

RIVER FORECASTING TECHNIQUES IN KOREA,
Ministry of Construction, Seoul (South Korea).
Yun Sik Lee.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 103-109, 1969. 7 p, 3 fig, 2 tab.

Descriptors: *Flood forecasting, *Statistical methods, *Warning systems, Flood control, Routing, Rainfall-runoff relationships, Stage-discharge relations, Flood protection, River forecasting.
Identifiers: *Republic of Korea.

Flood forecasting methods used in the Republic of Korea include graphically correlating the stages of the country's rivers with each other, and using stage-travel time relations to predict arrival of floods downstream from observation points. Because the country cannot afford flood control reservoirs or channel improvements, a disaster prevention law was enacted to integrate national flood damage prevention and relief work. (Knapp-USGS)
W70-07176

DEVELOPMENT OF A FLOOD-FORECASTING SYSTEM FOR THE LATROBE RIVER AT YALLOURN,
Bureau of Meteorology, Melbourne (Australia).
G. Heatherwick.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 110-132, 1969. 23 p, 16 fig, 7 tab, 2 ref.

Descriptors: *Flood forecasting, *Unit hydrographs, *Data processing, Recession curves, Hydrograph analysis, Streamflow forecasting, Stream gages, Rain gages, Rainfall-runoff relationships, Depth-area-duration analysis.
Identifiers: Australia, Latrobe River.

The procedures currently used for the development of flood-forecasting systems in Australian conditions are briefly outlined. Operational systems have been based entirely on the prediction of streamflow direct from rainfall. Because of the need to reduce the volume of data to a minimum the emphasis has been on simplicity. This led to the establishment of unit hydrograph analysis and digital data reduction systems which deal adequately with average situations but lack the flexibility to handle unusual ones with the same accuracy. (Knapp-USGS)
W70-07177

FLOOD HYDROGRAPH CALCULATION WITH RUN-OFF TRANSFORMATION IN BASIN AND CHANNELS TAKEN INTO ACCOUNT,
D. A. Burakov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 139-146, 1969. 8 p, 2 fig, 4 tab, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Overland flow, *Streamflow forecasting, *Snowmelt, Marshes, Hydrograph analysis, Mathematical models, Water storage, Permeability, Infiltration.
Identifiers: USSR, Ob River, Irtysh River.

A method is given for solving problems of flood hydrograph calculation approximately at the confluence of the two largest rivers of the Soviet Union, the Ob and the Irtysh. The region is extremely flat, with a poor drainage network, and is almost completely swampy. The main phase of the water regime of the rivers is flood resulting from snowmelt and rainfall. Runoff is considerable, especially when heavy rains occur soon after snowmelt. In such years the rainfall runoff exceeds that of the snowmelt. Rainfall-flood hydrographs should be calculated with the specific physio-geographical conditions taken into account. In the river basins of the region under study, where the ground is mostly swampy, the forest soils are characterized by great permeability and groundwater is close to the surface. In deriving the runoff equations it is supposed that the nature of water absorption is similar to water retention on the surface of an impermeable basin with non-uniform distribution of depression capacity. The scheme outlined can be used for calculation and forecasts of rainfall runoff from rain-

fall data in regions with flat relief where overland runoff transformation is important. (Knapp-USGS)
W70-07178

FLOOD-WAVE FORMATION,
University Coll., Galway (Ireland); and State Rivers and Water Supply Commission, Melbourne (Australia).
For primary bibliographic entry see Field 02A.
W70-07179

THE FORMATION AND FORECASTING OF RAINFALL FLOODS,
I. N. Gartsman, and V. M. Lylo.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 156-161, 1969. 6 p.

Descriptors: *Rainfall-runoff relationships, *Routing, *Flood forecasting, Streamflow forecasting, Infiltration, Antecedent precipitation, Precipitation intensity, Unit hydrographs, Recession curves.
Identifiers: USSR.

A characteristic of the rivers of far-eastern regions of the U.S.S.R. is that floods occur repeatedly. The probability of heavy flooding is the same throughout that part of the year which is free from basal ice of rivers, even after a long period of drought. Every year in some region or other the floods on rivers attain catastrophic proportions, and in some seasons they take place in widely separated places. The flood runoff is formed in a number of stages: the precipitation of rain into catchment areas and its partial expenditure in loss; the formation of runoff when delivery exceeds the discharge; removal; flow into the river system; and the evacuation of floodwaters through the channel systems. In considering the processes which lead to the formation of floods, it is necessary to distinguish two types of runoff formation which have different causes. The first type, surface runoff formation, takes place when the intensity of rainfall exceeds the absorptivity of the soil surface. The second type of runoff formation occurs when the stored soil moisture exceeds the minimal moisture content or critical water-holding capacity. In far-eastern conditions it forms mainly in soil depths of up to one metre, and more rarely up to two metres. Both types of runoff formation cease as soon as rain ceases. Equations are presented for calculating both types of runoff formation using rain and stream gaging data, routed by the isochrone method. (Knapp-USGS)
W70-07180

DIGITAL SIMULATION METHODS FOR HYDROLOGICAL FORECASTING,
Stanford Univ., Calif.
N. H. Crawford.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 162-171, 1969. 10 p, 10 fig, 2 ref.

Descriptors: *Simulation analysis, *Mathematical models, *Streamflow forecasting, *Synthetic hydrology, *Computer programs, Model studies, Hydrograph analysis, Routing, Optimization.
Identifiers: *Stanford Watershed Model.

Streamflow simulation attempts to develop algorithms of hydrological processes for quantitative calculations. The method is based on the premise that hydrological reactions are deterministic; if two similar storms result in different hydrographs it is assumed that physically consistent processes at work in each of the storms were responsible. Hence if these physical processes could be adequately documented and modelled, the model should reproduce the reaction from both storms. Stanford Watershed Model IV, the most recent documented program developed by the Stanford Project in Hydrologic Simulation, is used for illustration. Flow charts for this program are shown. When streamflow simulation is operated for forecasting, problems are encountered due to partial data, data errors and conflicting evidence from the analysis of these data. Straightforward information display, and programming that allows an interaction between man and machine during forecast operations, are valuable. This insures that anomalous data or results are detected quickly. Programming that explores automatic error-resolution and man/machine interaction in forecast operations is currently under way at Stanford University. (Knapp-USGS)
W70-07181

MATHEMATICAL MODELLING OF THE RUN-OFF PROCESS OF RIVERS WITH COMPOUND ALiMENTATION,
For primary bibliographic entry see Field 02A.
W70-07182

THE APPLICATION OF CONCEPTUAL CATCHMENT MODELS TO RIVER FORECASTING,
Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 04A.
W70-07183

SHORT-TERM FLOOD FORECASTING WITH THE RETENTION MODEL,
New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 04A.
W70-07184

FLOOD FORECASTING AND CONTROL OF THE LEVEL OF LAKE BURLEY GRIFFIN,
Commonwealth Dept. of Works, Canberra (Australia).
For primary bibliographic entry see Field 04A.
W70-07185

SEASONAL LOW-FLOW FORECASTING,
Geological Survey, Washington, D.C.
H. C. Riggs, and R. L. Hanson.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, 286-299, 1969. 14 p, 17 fig, 8 ref.

Descriptors: *Low flow, *Base flow, *Streamflow forecasting, Recession curves, Meteorology, Routing, Mathematical models, Hydrograph analysis.
Identifiers: Low-flow forecasting.

Methods of forecasting low flow of streams with and without gaging stations are reviewed. To be of value, most forecasts of seasonal low flows should be made a month or more in advance. Thus usable forecasts may be made only on streams having a substantial base-flow component. The base-flow recession curve, used for several forecasting examples in this paper, is a rather imprecise tool. Groundwater concepts and aquifer characteristics may be used to forecast assured flow; in its present state of development the method requires considerable information in the basin and produces results comparable to those obtained from base-flow recession curves. Forecasting relations may be adequately defined graphically; there is little justification for an involved mathematical treatment. Selection of a forecasting procedure for a specific stream should be preceded by a brief study of the hydrology of the basin. Then the data available and the purpose of the forecast should indicate a suitable approach. (Knapp-USGS)
W70-07186

THE METHOD OF INFLUENCE-FUNCTION DETERMINATION FOR LINEAR RUN-OFF MODELS,
L. S. Kutchment.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 312-319, 1969. 8 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Hydrograph analysis, *Rainfall-runoff relationships, *Mathematical models, *Streamflow forecasting, Linear programming, Equations, Mathematical studies, Unit hydrographs.
Identifiers: USSR.

In the calculation of runoff hydrographs, very often the hydrological objects (watershed, river sections) are looked upon as linear dynamic systems with lumped parameters. In such cases, the relation between input characteristics q (t) (hyetograph, inlet hydrograph, etc.) and the hydrograph at outlet Q (t) is expressed by the Duhamel integral, in which P (t) is the influence function on Q (t) of inlet characteristics. It is very easy to determine p (t) when the water delivery q (t) takes place for a short time (when q (t) is a delta function), or when it remains constant for a long time. In the first case, the hydrograph at the outlet is the influence-function multiplied by the volume of water delivery, and in the second case, it is the integral of the influence-function multiplied by the constant value of q (t). However, it is not always possible to find such limiting cases in field observations, and it is necessary to determine the influence-function for any type of function q (t) and Q (t). When using field measurements, which always contain errors, the initial functions cannot be given with absolute accuracy. In order to avoid such errors, one has to look for an optimal influence-function which would on the average satisfy the available information. An optimal influence-function was determined using observation data on the rivers Tvertsa and Svir in the downstream pool of Ivankov hydro-electric station and the observations for rainfall and runoff in the Kolima River basin. The methods discussed gave satisfactory results. (Knapp-USGS)
W70-07187

FLOOD-FORECASTING FROM DISCHARGE DATA IN DRAINAGE NETWORKS AND FROM PRECIPITATION,
V. I. Sapozhnikov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 307-311, 1969. 5 p, 1 tab, 12 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Streamflow forecasting, *Runoff forecasting, Hydrograph analysis, Equations, Unit hydrographs.
Identifiers: USSR.

Rainfall-runoff relationships and routing methods used to forecast streamflow and floods in the USSR are reviewed and briefly described. The techniques include travel time curves, unit hydrographs, lag methods, and flood wave attenuation calculations. The equations used for each calculation are presented and explained. (Knapp-USGS)
W70-07188

ELEMENTS OF PREDICTION OF RUN-OFF FROM SMALL CATCHMENT BASINS,
J. Lambor.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 263-285, 1969. 23 p, 12 fig, 2 tab, 8 ref.

Descriptors: *Flood forecasting, *Streamflow forecasting, *Mathematical models, *Routing, *Meteorology, Synoptic analysis, Statistical methods, Simulation analysis, Model studies, Runoff forecasting, Water management (Applied), Hydrograph analysis, Unit hydrographs.
Identifiers: Small catchments.

Methods of forecasting runoff from small catchments are reviewed and briefly described. The principal difference between warnings and forecasts is that warnings are long-range but only qualitative predictions, while forecasts are short-range but quantitative. Hydrological forecasts are formulated from hydrological elements, and meteorological forecasts are derived from meteorological elements. Both types can be based on direct interpretation of events which have already happened and of their development in the immediate future; they are commonly called short-range forecasts. To this category belong the prediction of water stages in the lower stream reaches based on stage observations in the upper reaches, or runoff prediction from recorded precipitation data, or short-range meteorological forecasts based on the barometric situation. Medium-range forecasts are based on physical interpretation of the genesis of a hydrometeorological event and its expected development, for example the development of the barometric situation, the character of air masses, or the condensation processes of water vapour. Long-range statistical forecasts, hydrological as well as meteorological, are based on statistical treatment of the observed phenomena. (Knapp-USGS)
W70-07189

THE REPRESENTATIVE BASIN CONCEPT IN AUSTRALIA.
Australian Water Resources Council, Canberra.
For primary bibliographic entry see Field 07A.
W70-07191

NEW ENRICHMENT AND MULTIPLE SAMPLING PROCEDURES TO INVESTIGATE RADIOACTIVE TRACER MIXING IN A SMALL RIVER,
Agricultural Research Council of Central Africa, Salisbury (Rhodesia).
For primary bibliographic entry see Field 07B.
W70-07196

PRINCIPLES FOR THE DISTRIBUTION OF INFORMATION HYDROLOGIC POSTS,
For primary bibliographic entry see Field 07A.
W70-07199

A METHOD FOR COMPUTING THE RUNOFF COMPONENT OF LEVEL FLUCTUATIONS AT RIVER MOUTHS,
V. V. Ivanov.
Trans. from Trudy AANII, Vol 283, p 12-29, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 600-615, 1968. 6 fig, 44 ref.

Descriptors: *Water level fluctuations, *Runoff forecasting, *Runoff coefficient, *Stage-discharge relations, Rivers, Winds, Channel morphology, Hydrometry, Gaging stations, Coasts.
Identifiers: *USSR.

A method is proposed for computing the runoff component of water level fluctuations in the mouth reaches of rivers. Some of the problems that may be treated are: (1) computation of wind-induced level changes in the mouth reaches of rivers; (2) comparison between wind-induced and tidal level fluctuations in the mouth reaches of rivers and in the mouth coastal waters; (3) determination of secondary effects of river runoff on their transformation when the fluctuations move upstream; (4) analysis of water regime and channel deformations in a zone of variable backwater; (5) application of the characteristic levels computed for reference gaging stations on the river and in the sea to water-gaging stations in the mouth region. (Carstea-USGS)
W70-07203

PRINCIPLES FOR DISTRIBUTION AND PROSPECTS FOR DEVELOPMENT OF A HYDROLOGIC NETWORK,
For primary bibliographic entry see Field 07A.
W70-07205

TECHNIQUES FOR EVALUATING LONG-TERM RESERVOIR YIELDS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 06A.
W70-07234

RECENT ADVANCES IN STORAGE AND FLOODING THEORY,
Office of Naval Research, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-07236

THE FULLY-MIXED STREAM TEMPERATURE REGIME,
Tennessee Valley Authority, Norris.
Walter O. Wunderlich.
Presented at ASCE Specialty Conference, Utah State University, Utah, August 20-23, 1969. Typescript, July 1969. 35 p.

Descriptors: *Temperature, *Thermal stratification, Turbulence, Heat flow, Energy budget, Rivers, Streams, Reynolds number, Boundary layers, Air-water interfaces, Heat transfer, Velocity, Channel flow, Diffusion, Radiation, Evaporation.
Identifiers: Thermal stratification stability criteria.

The thermo-hydrodynamic criteria are derived which can be used to determine whether the vertical heat distribution in a stream can be considered as homogeneous (fully mixed) or whether the streams will straifty or maintain an existing stratification. The internal turbulence in many streams is sufficient to assure instantaneous heat distribution from the surface downward. Layers of warm water on top of cold water may, however, appear and persist as soon as the turbulence decreases or is nonexistent as, for example, in stagnant bodies of water. Field data from two rivers, one in the process of warming, the other in the process of cooling, are used to demonstrate practical applications of the criteria. The criterion is based on comparison of meteorological Nusselt number with a dynamic transfer number which describes turbulent heat exchange in the body of flowing water. (Novotny-Vanderbilt)
W70-07324

EVALUATION OF NATURAL RIVERS,
Antioch Coll., Yellow Springs, Ohio.
For primary bibliographic entry see Field 06B.
W70-07327

FORMATION OF HYDRAULIC JUMPS IN A ROTATING SYSTEM,
Naval Postgraduate School, Monterey, Calif., and Utah Univ., Salt Lake City.
For primary bibliographic entry see Field 08B.
W70-07354

A RAINFALL-RUNOFF SIMULATION MODEL FOR ESTIMATION OF FLOOD PEAKS FOR SMALL DRAINAGE BASINS--A PROGRESS REPORT,
Geological Survey, Fort Collins, Colo., and Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02A.
W70-07365

WATER RESOURCES OF SOUTHERN MARYLAND,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07367

CHANGES IN NATURAL CHANNELS DOWNSTREAM FROM MAN-MADE RESERVOIRS,
Mississippi State Univ., State College. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-07519

SNOWPACK DENSITY, WATER CONTENT AND RUNOFF ON A SMALL ARIZONA WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
For primary bibliographic entry see Field 02C.
W70-07531

SOIL-WATER FREEZING, SNOW ACCUMULATION AND ABLATION IN MARMOT CREEK EXPERIMENTAL WATERSHED, ALBERTA, CANADA,
Department of Fisheries and Forestry, Calgary (Alberta).
For primary bibliographic entry see Field 02C.
W70-07533

2F. Groundwater

GROUND-WATER RESOURCES OF BASTROP COUNTY, TEXAS,
Geological Survey, Austin, Tex.
C. R. Follett.
Texas Water Development Board Report 109, March 1970. 138 p, 26 fig, 13 tab, 32 ref.

Descriptors: *Hydrologic data, *Groundwater, *Aquifers, *Texas, Water yield, Water wells, Water levels, Water quality, Water utilization, Data collections, Water supply, Sandstones.
Identifiers: Bastrop County (Tex).

The principal formations in Bastrop County, Texas that yield or are capable of yielding moderate or large quantities of water to wells are, in order of decreasing yields, the Wilcox Group, Carrizo Sand, Queen City Sand, and Sparta Sand. The Carrizo Sand and the underlying Wilcox Group are connected hydrologically and function as a single aquifer. The use of groundwater is gradually increasing, but the total of 3.7 mgd or 4,100 acre-feet per year used in 1966 is small compared to the quantity available. About 100 million acre-ft of fresh to slightly saline water is in transient storage in the principal aquifers, but only a fraction of this water is economically recoverable by known methods at present costs. The yields of wells in Bastrop County range from a few gallons a minute to about 1,800 gpm. Yields of at least 2,000 gpm are possible from properly constructed and screened wells in the Carrizo-Wilcox aquifer. The dissolved-solids content of selected water samples ranged from 67 to 4,020 mg/liter; 49% of the samples contained less than 500 mg/liter. Excessive iron is one of the county's chief water-quality problems as 74% of the samples contained more than 0.3 mg/liter iron. Most of the water sampled was moderately hard to very hard; about 80% of the samples exceeded 60 mg/liter hardness. (Knapp-USGS)
W70-07165

DETERMINATION OF GROUNDWATER AGES BY THE TRITIUM -- 3 He METHOD,
Institute of Precambrian Geology and Geochronology, Leningrad (USSR); and All-Union Petroleum Geology Exploration Inst.
For primary bibliographic entry see Field 07B.
W70-07168

DIRECTIONAL HYDRAULIC BEHAVIOR OF A FRACTURED-SHALE AQUIFER IN NEW JERSEY.,
Geological Survey, Trenton, N.J.
John Vecchioli.

French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 318-326, 1967. 9 p, 6 fig, 4 ref.

Descriptors: *Hydraulic properties, *Aquifers, *Shales, *Fractures (Geology), *New Jersey, Groundwater, Groundwater movement, Transmissivity, Fissures (Geology), Water sources, Geology, Water circulation, Water levels, Permeability, Faults (Geology), Water wells, Drawdown, Discharge (Water).
Identifiers: *Brunswick shale aquifer (N J).

The Brunswick shale of the Triassic age, which is the principal source of groundwater in the central and northeastern part of New Jersey, exhibits directional hydraulic behavior. Water levels in wells aligned along the strike of the formation show greater magnitude of interference than those aligned perpendicular to strike. Drawdown data evaluated by standard-time-drawdown methods indicate that computed transmissivity coefficients are smallest in the direction of strike. The relation of the directional behavior to the structure is of practical significance in locating new wells, to minimize interference. (Gabriel-USGS)
W70-07213

HYDROGEOLOGY OF SOME KARSTIC AREAS OF GREECE,
Food and Agriculture Organization of the United Nations, Athens (Greece).
David J. Burton.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 308-317, 1967. 10 p, 5 tab, 13 ref.

Descriptors: *Hydrogeology, *Hydrologic properties, *Karst, *Groundwater, Fissures (Geology), Limestones, Dolomite, Water circulation, Permeability, Saturated flow, Sea water, Water levels, Springs, Discharge (Water), Drainage, Aquifers, Quaternary period, Water resources, Porosity, Geology, Geochemistry, Transmissivity, Water chemistry.
Identifiers: *Greece, Parnassos-Ghiona area, Argos-Tripolis area, Crete, Kephalonia.

The hydrogeology of fractured rocks of four karstic areas of Greece was investigated. Some of the data obtained were compared with the chemical composition of groundwater in carbonate aquifers of several circum-Mediterranean countries. The observed permeability variations indicate some primary porosity but the solutionally enlarged fissures through which the groundwater circulates in the carbonate rocks of Greece are joint systems and faults induced by the Alpine orogeny. There are marked chemical and hydrologic differences between the saturated zones perched on impermeable formations and those controlled by the base saturation level. Sea level changes have resulted in several karst levels. Some marine contamination in small amounts has been detected by hydromechanical methods. (Grabriel-USGS)
W70-07214

KARSTIC PHENOMENA IN THE MIOCENE GYPSUMS OF SYRIAN JEZIREH-NORTHEAST SYRIA (IN FRENCH),
Francois Mortier, and Chafic Safadi.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 334-338, 1967. 5 p, 1 fig, 6 ref.

Descriptors: *Karst, *Aquifers, *Gypsum, Water circulation, Geology, Hydrologic properties, Limestones, Water resources, Water sources, Fissures (Geology), Permeability, Geochemistry, Discharge (Water), Water wells, Hydrogeology, Groundwater basins.
Identifiers: *Syria, Jezireh.

Karstic areas of gypsum rocks in northeastern Syria were investigated. The Miocene gypsum and anhydrite formations contain karstic aquifers. Karstification is more common in tectonic zones and low-lying outcrop areas including closed basins and valleys. A method of accelerated dissolution for the development of wells in gypsum areas is briefly described. (Gabriel-USGS)
W70-07215

STUDIES ON THE HYDROLOGY OF FRACTURED ROCKS IN JAPAN,
Tokyo Univ. (Japan).
Soki Yamamoto.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 340-342, 1967. 3 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Hydrologic properties, *Aquifers, *Karst, *Volcanoes, Geophysics, Geology, Mineralogy, Siesmic properties, Seismic studies, Electrical studies, Radioactivity, Core drilling, Discharge (Water).
Identifiers: *Japan, Mt. Fuji, Mt. Aso.

The fractured volcanic rocks of Japan were investigated for the purpose of locating good aquifers by using geological, geophysical (seismic, electric, etc.) and hydrological methods. Many buried valleys formed in mud flows and later covered by lava flows are discharged by several springs. Study of the Mt. Fuji aquifers shows that the springs of the mountain are associated with either perched or buried valley aquifers. (Gabriel-USGS)
W70-07216

THE GROUNDWATER INVESTIGATION IN THE DEVONIAN LIMESTONES, EAST OF ISTANBUL, TURKEY,
Technical Univ. of Istanbul (Turkey). Dept. of Applied Geology.
Kemal Erguvanli.
In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 343-347, 1967. 5 p, 1 fig.

Descriptors: *Aquifers, *Hydrologic properties, *Industrial water, *Water supply, *Water sources, Discharge (Water), Water yield, Geology, Water levels, Geochemistry, Water wells, Groundwater movement, Limestones, Dams, Reservoirs.
Identifiers: *Turkey, Istanbul.

Geological and hydrological characteristics of Devonian limestones located 25 km east of Istanbul, Turkey were investigated during the 1959-1956 period to locate sufficient water for a factory. More than 150 boreholes were made and their water was analyzed for NaCl content. Water yields of 2-3 liters/sec may be obtained; however, the construction of a small dam (10,000 cu m capacity) and the recycling of used water should greatly increase the amount of available water. A detailed geological map of the studied area is included. (Gabriel-USGS)
W70-07217

GROUNDWATER STORAGE PROBLEMS IN SOUTHEAST SPAIN (IN FRENCH),
Agustin Navarro, and Antonio Almela Sampler.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 378-380, 1967. 3 p.

Descriptors: *Groundwater, *Hydrogeology, *Arid lands, *Groundwater basins, *Water storage, Rainfall, Deserts, Precipitation (Atmospheric), Aquifers, Climates, Water resources, Water sources, Dischager (Water), Dolomite, Limestones, Geology, Hydrologic properties, Water wells, Porosity, Fissures (Geology).
Identifiers: *Spain.

The geographical region embracing southeastern Spain is extremely arid with annual rainfall of barely 225 mm. The climate is, however, extremely favorable for high-value cash crops and accordingly the estimation of the groundwater reserves is extremely important. Comparative figures of the percentages of water stored in the various formations of this part of Spain are given. The tectonics, metamorphism and composition are the main factors determining water storage capacity in calcareous terrains. A few concrete cases are given of unsound exploitation which has caused grave damage regionally. Although the figures given are only of real validity for the geological formation and tectonic area specified, they can provide pointers for other rocks and for similar regions. (Grabriel-USGS)
W70-07218

AN EXPERIMENTAL BASIN IN CALCAREOUS FORMATIONS - THE SAUGRAS BASIN, LANGUEDOC, FRANCE (IN FRENCH),
Montpellier Univ. (France), Center of Hydrologic Studies and Research.
C. Drogue.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 381-386, 1967. 6 p, 3 fig, 1 tab.

Descriptors: *On-site investigations, *Aquifers, *Limestones, Dolomite, Springs, Hydrologic properties, Runoff, Water balance, Water storage, Water resources, Hydrologic data, Geology, Hydrogeology, Evapotranspiration, Rainfall, Rainfall intensity, Rain gages, Fissures (Geology), Water sources.
Identifiers: *France, Experimental watersheds, Saugras basin, Languedoc (France).

An experimental basin has recently been installed on a calcareous massif in the south of France. Complete isolation of the aquifer and the localization of springs enables the runoff factor of the water-balance equation to be measured under the best conditions to make it possible to calculate the evapotranspiration characteristic of the type of karst observed here. Study, on a semi-experimental basis, relates the various factors that affect runoff deficit. (Gabriel-USGS)
W70-07219

THE INFLUENCE OF KARST ON THE MAXIMUM FLOW OF THE RIVERS OF THE EAST EUROPEAN PLAINS,
O. L. Markova.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 387-401, 1967. 15 p, 4 fig, 6 tab.

Descriptors: *Karst, *Hydrogeology, *Rivers, Hydraulic properties, Runoff, Drainage, Water storage, Floodwater, Aquifers, Discharge (Water), Geology, Hydrologic properties, Groundwater, Lakes, Swamps, Rainfall-runoff relationships.
Identifiers: *Eastern Europe.

The effect of karst on the maximum river flows was investigated on the basis of geological and hydrological data recorded at the gaging stations located in the plains of Eastern Europe. High accumulation and absorption capacity of karstic formations leads to a decrease of the surface runoff coefficients and flood volumes, carried by karstic rivers. The index of surface runoff decreases and the maximum discharge increases with surface karstic area. Karstic rivers draining basins of over 500 sq km are characterized by runoff indices smaller than 50 or 60. The effect of karst in basins of less than 500 sq km is difficult to identify and, in general, is variable. (Gabriel-USGS)
W70-07220

INVESTIGATION OF KARSTIC WATER RESOURCES PRESENT UNDER MIOCENE-PLIOCENE-QUATERNARY BLANKET IN THE MEDITERRANEAN BASIN AND THEIR MAGNITUDE ON THE BASIS OF SOME RECENT EXPERIENCES IN THE LANGUEDOC-ROUSSILLON REGION, FRANCE (IN FRENCH),
Montpellier Univ. (France), Center of Hydrologic Studies and Research.
Jacques Avias.
English abstract included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965). International Association of Scientific Hydrology, Publication No 73, p 410-419, 1967. 10 p, 7 fig, 5 ref.

Descriptors: *Karst, *Water resources, *Groundwater movement, *Water storage, Groundwater, Basins, Limestones, Dolomite, Rainfall, Geology, Geophysics, Sands, Sandstones, Faults (Geology), Seismic studies, Hydrologic properties, Hydraulic properties, Fissures (Geology), Hydrometry.
Identifiers: *France, Mediterranean Basin, Languedoc-Roussillon.

The limestone-dolomite massifs of the Mediterranean Basin, characterized by their strong fissurization and karstification, were investigated by using geological, geophysical, hydrochemical, and hydrologic observations. The parts of these massifs that are hidden under miocene-Recent sediments often constitute excellent water reserves, a fact which is responsible for the wide application of various methods in exploration for water in the basin. (Gabriel-USGS)
W70-07221

HYDROGEOLOGY OF THE VOLCANIC ROCK FORMATIONS OF NORTHEASTERN MOROCCO (IN FRENCH),
Water Resources Service (Morocco), Dept. of National Irrigation.
F. Mortier, T. Nguyen Quang, and M. Sadek.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 327-333, 1967. 7 p, 3 fig.

Descriptors: *Hydrogeology, *Aquifers, *Igneous rocks, *Basalts, Limestones, Geology, Geologic investigations, Geophysics, Water wells, Kolomite, Karst, Water chemistry, Water balance, Discharge (Water), Fissures (Geology), Hydrologic properties, Water levels, Water circulation, Groundwater basins.
Identifiers: *Morocco, Oued Isly basin.

Hydrologic, geologic, and geophysical data of the Oued Isly basin and adjacent areas were analyzed for better understanding of the basin aquifers. Basalt and tuffs of Pliocene-Quaternary age form a groundwater conduit about 25 km in length. These poorly-exposed volcanics show a well-established continuity, on the basis of geological and geophysical data, and may be considered as a single aquifer. These volcanic rocks conduct groundwater from limestones, located in the upper part of the basin, across impervious formations to the southern Oujda limestones and alluvium of the lower end of the basin. (Gabriel-USGS)
W70-07222

CONTRIBUTION TO THE HYDROGEOLOGICAL STUDY OF LIMESTONE TERRAINS IN U.A.R.,
Egyptian Desert Inst., Cairo (Egypt). Dept. of Hydrogeology.
Ismail Mahmoud El Ramly.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 348-377, 1967. 30 p, 15 fig, 2 tab, 34 ref.

Descriptors: *Hydrogeology, *Aquifers, *Karst, *Limestones, Geochemistry, Dolomite, Hydrologic properties, Water wells, Fissures (Geology), Fractures (Geology), Transmissivity, Water storage, Groundwater, Climatic data, Geomorphology, Surface waters, Springs, Lakes, Runoff, Precipitation (Atmospheric), Water temperature, Discharge (Water).
Identifiers: *Egypt (UAR), Qattara.

Groundwater reservoirs in fissured limestones of the U.A.R. and the natural lakes of the Qattara Depression located in the western Desert of Egypt were investigated on the basis of geological, hydrogeological, and geochemical data. There is a very close relationship between the distribution of the joint systems and groundwater flows in some areas, and the majority of springs are due to the meteoric waters percolating through joints and solution channels. The temperature of groundwaters from carbonate aquifers varies from 19 deg C to 41 deg C and 3 water types can be identified: these are the chloride, bicarbonate, and sulfate types. (Gabriel-USGS)
W70-07223

THE REGIME OF THE DRYING UP OF LA FOUX DE LA VIS - PRELIMINARY STUDY (IN FRENCH).
J. Forkasiewicz, and H. Paloc.
In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 213-226, 1967. 14 p, 3 fig, 2 tab, 5 ref.

Descriptors: *Groundwater movement, *Karst, *Water circulation, *Flow characteristics, Water sources, Rain water, Precipitation intensity, Groundwater recharge, Dolomite, Geology, Water yields, Caves, Water level fluctuations, Mathematical studies, Hydrograph analysis.
Identifiers: *France, La Foux de La Vis, French Central Massif.

Discharge fluctuations of La Foux de la Vis aquifer, located in the French Centeral Massif, were analytically and experimentally investigated by using hydraulic and hydrologic data recorded from 1950 to 1961. The analysis of the discharge curves, both extrapolated and observed, shows the presence of three distinct discharge velocity decreases; however, the coefficients cannot be considered as entirely reliable for the evaluation of the hydrologic regime. By modifying a formula given by H. Schoeller (1948), the authors find a better and quicker method for the analysis of the regimes of karstic aquifers. (Gabriel-USGS)
W70-07224

SYNTHESIS OF HYDROGEOLOGIC INVESTIGATIONS CONDUCTED IN THE CALCAREOUS ROCKS OF ITALY, (IN FRENCH),
Italian Geologic Service, Rome.
A. Moretti, L. Pannuzi, G. Stampanoni, and N. Zattini.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 293-307, 1967. 15 p, 1 map.

Descriptors: *Hydrologic properties, *Karst, *Groundwater, *Groundwater basins, *Hydrogeology, Limestones, Dolomite, Geology, Structural geology, Water storage, Stratigraphy, Water table, Sea water, Springs, Discharge (Water), Fissures (Geology).
Identifiers: *Italy, Lombardy, Alps, Sardinia, Sicily, The Appennines.

The hydrogeologic characteristics of principal calcareous and dolomitic massifs of Italy, Sardinia, and Sicily are discussed on the basis of a distinction made between the major stratigraphic and structural units and the calcareous complexes forming some parts of the lithologically variable series. Water storage in these rock masses is associated with the regional lithostratigraphic and tectonic conditions and with subsurface and surface factors present in karstic regions. The springs associated with these chiefly Mesozoic rocks often have large and frequent discharges, especially in the central and southern Apennines, and are of overflow of purely karstic type in the calcareous massifs. (Gabriel-USGS)
W70-07225

KARST HYDRODYNAMICS - FLOW AND STORAGE (IN FRENCH),
H. Schoeller.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 3-20, 1967. 18 p, 7 fig, 6 tab.

Descriptors: *Groundwater movement, *Karst, *Mathematical studies, Water balance, Water circulation, Calcium carbonate, Springs, Fissures (Geology), Channel flow, Discharge (Water), Water measurement, Water sources, Flow rates, Aquifers, Aquifer characteristics.
Identifiers: *France.

The role of wide and fine channels and fissures in groundwater movement and the recession curves of spring discharges were analytically investigated. Various assumed geological and hydrological conditions of aquifers were calculated and the results compared with the discharge data of the Fontaine de Vaucluse, France, and several aquifers of the Arbailles Napias massif located in the Lower Pyrenees. The discussion includes, (1) discharge under the conditions of a neutral regime; (2) relative independence of various flow systems runoffs and water circulation in a aquifer; (3) water balance in a calcareous massif; (4) conditions induced by infiltration; and (5) calcareous layer with drainage. (Gabriel-USGS)
W70-07226

GEOLOGY AND GROUNDWATER RESOURCES OF THE NORTHERN PART OF THE SALAR DE ATACAMA, ANTOFAGASTA PROVINCE, CHILE,
Geological Survey, Washington, D.C.
Robert J. Dingman.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash. DC 20402. U S Geological Survey Bulletin 1219, 1967. 49 p, 11 fig, 1 plate, 4 tab, 18 ref.

Descriptors: *Groundwater, *Geology, *Water resources, *Arid lands, Water quality, Aquifers, Alluvium, Water wells, Water yield, Hydrologic data, Data collections, Hydrogeology.
Identifiers: *Chile, Antofagasta Province.

The Salar de Atacama is an undrained topographic basin in east-central Antofagasta Province, Chile. The region is underlain by Mesozoic and Cenozoic continental sedimentary rocks, which are divided into four formations, and deposits of ash flows, piedmont deposits, basalt, alluvium, eolian sand, and salt. Aquifers having moderate to large development potential occur in sediments in the basin of the Salar de Atacama. A test drilling program demonstrated that wells flowing as much as 70 liters per second and capable of being pumped at much higher rates could be obtained in the vicinity of San Pedro. The quality of the water, however, is rather poor, the dissolved-solids content is approximately 2,500 ppm and includes 15 ppm of boron. (Knapp-USGS)
W70-07227

AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02A.
W70-07232

OPTIMIZATION OF WELLS AND RECHARGE FACILITIES IN CONJUNCTIVE USE OF GROUNDWATER RESERVOIRS,
California Univ., Davis Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 04B.
W70-07325

LARGEST FLOWING WELL IN CANADA AT FORT ST. JAMES,
Robinson, Roberts and Brown Ltd, Vancouver (British Columbia).
For primary bibliographic entry see Field 04B.
W70-07361

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF THE MISSOURI RIVER ALLUVIUM BETWEEN JEFFERSON CITY AND MIAMI, MISSOURI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07368

FLOW PROBLEMS IN LIMESTONE PLAINS, JAMAICA, W. I. - A PROGRESS REPORT,
Food and Agriculture Organization of the United Nations (Jamaica).
D. H. Wozab, and J. B. Williams.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965) International Association of Scientific Hydrology, Publication No 73, p 402-409, 1967. 8 p, 3 fig, 3 ref.

Descriptors: *Karst, *Limestones, *Hydrogeology, Geology, *Groundwater movement, Water sources, Water resources, Groundwater, Swamps, Infiltration, Drainage, Faults (Geology), Evapotranspiration, Precipitation, Rainfall (Atmospheric), Permeability, Water levels, Water level fluctuations, Recharge.
Identifiers: *Jamaica (W I), The Pedro Plains.

The Pedro Plains, located on the southwest coast of Jamaica, comprise a low-lying area of partially karstified limestone terrain which slopes northwards into a wide area of swamp. The limestones are of Lower Miocene age, show a variable lithology, and are extensively faulted along NNW-SSE alignments. Structurally and hydrologically the Plains and the swamp can be considered as a single unit. Rainfall on the Plains average 50 inches, but there is practically no surface drainage. The water table, showing no relationship to topography, is virtually flat, with the exception of mounds along several of the faults. These mounds, together with a marked concentration of groundwater flow towards the north emphasize the influence of structural control on groundwater movement in the Plains. It is tentatively concluded that the source of recharge is external, and reaches the Plains under confined conditions through a faulted and karstified limestone horizon. The unconfined distribution of groundwater is also apparently fault-controlled, although some movement takes place through a previously established system of karst drainage. (Gabriel-USGS)
W70-07404

WATER SITUATION IN MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
Joe W. Lang.
Paper presented at Water Well Symposium, Proceedings Mississippi Society of Professional Engineers, Nov 16-17, 1965, Jackson, Mississippi, published 1967. 13 p, 7 fig.

Descriptors: *Water resources, *Mississippi, *Water Wells, *Hydrogeology, Water resources development, Management, Rainfall-runoff relationships, Water quality, Groundwater basins, Aquifer characteristics, Geologic control.
Identifiers: *Water resources framework.

Describes water-rich characteristics of the State, potential problems for developers and managers of water resources, and need for facts in understanding the environmental framework and the use of water within that framework. Of the annual rainfall (50 inches in the north to 64 inches on the coast) an average of 15 to 20 inches is runoff. The recoverable water supply totals 48 bgd. Except for the Mississippi River along the west boundary, groundwater is the largest most widespread source of fresh water. The 7,000 sq mi Delta is underlain by abundant hard water in the 140-ft section of alluvium; this, the coolest water (63F -66F) is used mostly for irrigation and cooling. Artesian systems in Tertiary and Cretaceous sand aquifers can yield from hundreds to several thousand gpm of soft sodium bicarbonate type water, mostly from depths ranging from a few hundred to more than 2,500 ft. Sand texture usually is medium to coarse, but fine sand is common in many places. Aquifers dip toward the south and west and water quality becomes more saline with depth. Maps show runoff, median dissolved solids at selected sites, areas of geologic sources, and groundwater quality and availability. Two hydrogeologic sections are presented showing electric logs, screen sections in wells, and water quality data. (Lang-USGS)
W70-07405

GEOPHYSICAL INVESTIGATIONS IN ALLUVIAL BASINS IN SOUTHERN ARIZONA,
Arizona Univ., Tucson. Dept. of Geophysics.
John S. Sumner.
Completion Report, (1970). 6 p. OWRR Project A-008-Ariz (1).

Descriptors: *Gravity studies, *Geophysics, Geologic control, Hydrogeology, *Analytical techniques, Exploration, Theoretical analysis, Arizona.
Identifiers: *Alluvial basins.

Geophysical measurements including gravity, magnetic, seismic and electrical exploration techniques have been tried in the alluvial basins of S. Arizona. The object of this work has been to determine the subsurface boundaries of the hydrogeologic basins and the hydrologic parameters of the basins when possible. It can be concluded that the subject geophysical surveys indeed locate the structural boundaries of alluvial basins in S. Arizona. Also, from knowledge of subsurface densities and inferred rock type, estimates of groundwater reserves can be made. Thus the objectives of this research have been largely met in the areas that have been investigated geophysically. The second phase of this research project has been an extension of the geophysical survey work in alluvial basins near Tucson to adjoining areas in S. Arizona. Part of this continuing program is dependent upon gravity data being gathered by the Army Map Service as their part of a joint statewide survey program with the Geophysics Lab at the University of Arizona. Unfortunately their field program has not kept pace, and we are still awaiting their gravity results. An interpretive method for analyzing gravity data has been developed to determine the approximate amount of groundwater in basins and sedimentary valleys. When more gravity survey data becomes available, it will be possible to access the amount of groundwater actually present in these valleys.
W70-07554

2G. Water in Soils

SOME COMMENTS ON REFLECTANCE MEASUREMENTS OF WET SOILS,
National Environmental Satellite Center, Washington, D.C. Satellite Experiment Lab.
For primary bibliographic entry see Field 07B.
W70-07155

A MOVING-BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS-FLOW SYSTEM,
Stanford Univ., Calif.
George M. Hornberger, and Irwin Remson.
Typescript, 1969. 23 p, 9 fig, 15 ref. NSF Grant 4525.

Descriptors: *Mathematical models, *Flow, *Porous media, *Saturated flow, *Unsaturated flow, Drainage, Water.
Identifiers: *Taylor series method, Finite-difference method.

A moving-boundary model was proposed for one-dimensional transient flow of water through a porous media of which part was saturated and part unsaturated. The model was based upon a theory which implies a discontinuous propagation of pore pressure at the saturated-unsaturated interface. The moving-boundary model was used to study a gravity drainage problem. Two numerical procedures were developed to solve the problem, an approximate Taylor series method and a finite difference method. The validity of the methods was appraised by comparing the results with experimental data given by Watson. The Taylor series method was limited in applicability because of a need for accurate determination of derivations of hydraulic conductivity and of moisture content with respect to pressure head. The finite-difference solution was very efficient because only changes in the unsaturated region were computed and the need for iteration was obviated. (Kriss-Cornell)
W70-07233

EVALUATION OF THE EFFECTS OF REDUCED TRANSPIRATION UPON SOIL MOISTURE RETENTION IN AN ASPEN STAND THROUGHOUT THE GROWING SEASON IN NORTHERN UTAH,
Utah Center for Water Resources Research, Logan.
For primary bibliographic entry see Field 03B.
W70-07331

SOIL SYSTEMS FOR LIQUID WASTE TREATMENT AND DISPOSAL: ENVIRONMENTAL FACTORS,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
For primary bibliographic entry see Field 05D.
W70-07348

ULTIMATE DISPOSAL OF WASTES TO SOIL,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05E.
W70-07383

2H. Lakes

HIGH-MAGNESIAN CALCITE AND PROTODOLOMITE IN LAKE BALATON (HUNGARY) SEDIMENTS,
Heidelberg Univ. (West Germany). Sediment Research Lab.
For primary bibliographic entry see Field 02J.
W70-07153

PHYSICAL AND CHEMICAL LIMNOLOGY OF TWO MOUNTAIN LAKES IN BANFF NATIONAL PARK, ALBERTA,
Calgary Univ. (Alberta); and Canadian Wildlife Service.
R. Stewart Anderson.
Journal of the Fisheries Research Board of Canada, Vol 27, No 2, p 233-249, 1970. 7 fig, 3 tab, 35 ref.

Descriptors: *Lakes, Limnology, Physical properties, Water temperature, Alpine, Water circulation, Thermal radiation, Thermal stratification, Chemical stratification, Oxygen, Hardness (Water), Hydrogen ion concentration, Nutrients, Light.
Identifiers: Subalpine lakes, Vernal circulation, Trophogenic zone, Banff National Park (Canada).

Study of an alpine and a subalpine lake revealed that their vernal circulation does not always reach the bottom, whereas the complete autumnal circulation persists for several weeks. The difference in heat incomes of the two lakes was confined to summer when the alpine lake was cooled by water renewal. The subalpine lake showed a better defined thermal stratification and a very low concentration of oxygen in deep water strata. Well-defined chemical stratification was of short duration in both lakes. Cloudy ice and deeper snow cover of the subalpine lake reduced penetration of visible light. The trophogenic zone extended to the bottoms of both lakes (about 13 meters) for a portion of the year. (Wilde-Wisconsin)
W70-07252

PRODUCTIVITY OF MACROPHYTES IN MARION LAKE, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Zoology.
Gordon S. Davies.
Journal of the Fisheries Research Board of Canada, Vol 27, No 1, p 71-81, 1970. 6 fig, 5 tab, 13 ref.

Descriptors: *Productivity, *Phytoplankton, Analysis, Bicarbonate, Periphyton, Aquatic plants, Herbivores, Carbon radioisotopes.
Identifiers: *Macrophytes, Marion Lake (Canada), Sodium bicarbonate, Vascular plants, Lake flushing, C-14 analysis, Organic weight method.

A comparison of the relative productivity of macrophytes and phytoplankton was accomplished by C-14 analyses. Paired samples of water were inoculated with labelled sodium-hydrogen carbonate, incubated at the depth of collection for 4-6 hours, and the activity was determined at the International Agency for C-14 analyses in Denmark. To determine the uptake of carbon by macrophytes, they were enclosed in Plexiglas chambers with sodium carbonate and following a 4-hour incubation combusted in oxygen. The carbon dioxide was absorbed in toluene-POPOP-ethanolamine. Radioassay was accomplished by liquid scintillation. The total productivity of the lake was very low, in a large part because of the inhibited development of phytoplankton. Considerable differences were recorded in the estimates of productivity of the macrophytes made by C-14 and organic weight methods, but both analyses indicated that the productivity of macrophytes is always higher than that of phytoplankton. (Wilde-Wisconsin)
W70-07253

EUTROPHICATION, PAST AND PRESENT,
Yale Univ., New Haven, Conn.
G. E. Hutchinson.
Eutrophication: Causes, Consequences, Correctives, p 17-26. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 37 ref.

Descriptors: *Eutrophication, *History, Nutrients, Oligotrophic, Bogs, Color, Turbidity, Cyanophyta, Benthic fauna, Wisconsin, Phosphorus, Drainage, Basins, Sediments, Succession, Chrysophyta, Diatoms, Glaciation, Artemesia, Oak trees, Fir trees, Pollen, Elements (Chemical).
Identifiers: Chironomids, Coregonus, Dinobryon, Yaye Tso (Tibet), Mysis relicta, Green Lake (Wis), Chemical dynamics, Linsley Pond, Trophic equilibrium, Oscillatoria rubescens, Lac de Morat (Switzerland), Lake Llangors (Wales), Pyramid Lake (Nev), Gloeotrichia echinulata, Arthrospira, Lago di Monterosi (Italy).

Definitions of eutrophic, mesotrophic, and oligotrophic as applied to the classification of water types and the concept of classification of lakes based on their drainage basins and sediments forming oligotrophic or eutrophic systems are discussed. The stationary concentration of nutrients in assimilable form is of lesser import than the total potential concentration of nutrients and the rate at which it undergoes circulation. Viewing a lake as a dynamic trophic system, circulation speed is equally important as the sum of material available, as well as succession. Extreme oligotrophic lakes are deep and nutrient-deficient, do not produce water bloom, have an orthograde oxygen distribution, a stenoxybiont benthic fauna and Coregonus in the hypolimnion. Eutrophic types are shallow and nutrient-rich, produce water bloom, have a clinograde oxygen distribution, a euryoxybiont Chironomus fauna and no stenotopic hypolimnetic fishes. Whether extreme types of eutrophication are culturally induced or the water bloom is a natural phenomenon based on eutrophic equilibrium is considered. Lago di Monterosi is cited as a case in which cultural eutrophication was initiated by a subtle change in the hydrographic regime. (See also W70-03975). (Auen-Wisconsin)
W70-07262

BACTERIA IN LAKES: POPULATIONS AND FUNCTIONAL RELATIONS,
Wisconsin Univ., Madison.
Elizabeth McCoy, and William B. Sarles.
Eutrophication: Causes, Consequences, Correctives, p 331-339. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 1 fig, 4 tab, 17 ref.

Descriptors: *Bacteria, *Lakes, *Population, *Ecosystems, *Physiological ecology, Microbiology, Fresh water, Eutrophication, Water pollution, Nitrogen cycle, Nitrification, Nitrogen fixation, Nutrients, Food chains, Temperature, Oxygen, Wisconsin, Sulfur bacteria, Pigments, Fungi, Dystrophy, Technology, Depth, Bays, Beaches, Surfaces, Mud, Periphyton, Oligotrophy.
Identifiers: Mesotrophic, Gram-negative, Spirilla, Proteolytic pseudomonads, Eubacteriales, Micromonospora, Streptomyces, Chlamydobacterales, Beggiatoales, Pseudomonadales, Culture medium, Wisconsin lakes.

Only the so-called natural microflora of freshwater lakes is considered in an attempt to generalize on the probable function of bacteria in biological systems. Bacteria are the prime agents for degradation of dead organic matter to the soluble state, and for the return of soluble organic nutrients to the biological system. By using such nutrients in their own growth, heterotrophic bacteria become particulate matter, are food for protozoa, which in turn are food for higher metazoa, leading ultimately to fish. 'Most probable number' counts for important physiological groups of bacteria in lake flora show that a well-balanced mixture is present to effect degradation of chitin, cellulose, pectins, proteins, and other complex organic compounds. A resolution of the eutrophication problem requires answers to: Does eutrophication involve a change in number or kinds of bacteria within the 'natural' microflora. What is the fate of pollution bacteria in a lake advanced in eutrophication. What needs to be studied on the nitrogen cycle in a eutrophic lake. How important are nitrification and nitrogen fixation in view of recent studies on these bacterial processes. (See also W70-03975). (Jones-Wisconsin)
W70-07263

EASTERN EUROPEAN LAKES,
Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
Milan Straskraba, and Vera Straskrabova.
Eutrophication: Causes, Consequences, Correctives, p 65-97. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 11 fig, 4 tab, 127 ref.

Descriptors: *Eutrophication, *Lakes, Water quality, Reservoirs, Oxygen, Nitrogen, Zooplankton, Phytoplankton, Fish, Daphnia, Bacteria, Cyanophyta, Biological communities, Benthic flora, Indicators, Chlorella, Oligotrophy, Diatoms, Limnology, Fisheries, Depth, Color, Altitudes, Phosphorus, Biochemical oxygen demand, Chemical oxygen demand, Temperature, Primary production, Standing crop, Mesotrophic.
Identifiers: *Eastern European lakes, *Europe, Oocystis, Crucigenia, Microcystis, Biocenosis, Cladocera, Caspian Sea, Volga River, Relict fauna, Melosira, Coregonus, Coelastrum, Aphanizomenon, Transparency, Renewal time.

Detailed analyses of eutrophication in Eastern European lakes and reservoirs are given. Of primary importance to reservoirs is retention time and hydrology of inflow-outflow and biological properties. These basic differential factors are manifested in water level fluctuations, temperature, and stratification conditions decisive for nutrient utilization by phytoplankton and zooplankton. Understanding these interrelations provides a key to uniqueness of reservoir eutrophication processes. Although known, relation of bacterial increase with increasing pollution has not been proven. Bacterial reproduction increases more rapidly than primary production in comparable waters with increasing eutrophication and is a possible indicator of an allochthonous source of organic substances or a relatively lower degree of primary production utilization by zooplankton and consequent availability for bacterial decay. At higher trophic levels, direct relation between water nutrient content, its primary production, and amount of zooplankton seems no longer proportional. Biocenotical interrelations of different trophic links and reciprocal interactions must be considered. Influences of nonliving factors--nutrient supply--on primary producers, of primary producers on herbivores, and on through the food chain are recognized. With high fish populations, zooplankton are small Cladocerans and Rotifers; with low, chiefly larger Cladocerans. (See also W70-03975). (Jones-Wisconsin)
W70-07265

THE PROCESS OF EUTROPHICATION IN CENTRAL EUROPEAN LAKES,
Zurich Univ. (Switzerland); and Zurich Univ. (Switzerland). Cantonal Lab.
Eugene A. Thomas.
Eutrophication: Causes, Consequences, Correctives, p 29-49. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 3 fig, 2 tab, 57 ref.

Descriptors: *Eutrophication, *Lakes, Limnology, Oligotrophy, Phosphates, Nitrates, Rain water, Oxygen, Calcium carbonate, Seasonal, Depth, Bacteria, Toxins, Cyanophyta, Cycles, Denitrification, Sewage, Lake morphology, Food chains, Fish, Fertilization, Salmonids, Benthic fauna, Domestic wastes, Industrial wastes, Plant growth, Phytoplankton, Pipelines.
Identifiers: *Central Europe, Bavarian lakes, Salzkammergut lakes, Karnten lakes, Southern Alpine lakes, Savoyan lakes, Swiss midland lakes, Higher Alpine lakes, Europe, Lake sanitation, Cladophora glomerata.

Data from Central European lakes on nitrates and phosphates in surface water during the homothermic state and the summer stagnation period, the oxygen content in the hypolimnion, and the lime precipitation during summer stagnation is summarized. The maximal value of spring quantities of phosphate ions is characterized as the basic value; this basic value decreases to traces or zero during March-June. A lake may have a low basic value of phosphate ions, but high daily phosphate additions may instigate the eutrophication trend. The eutrophication mechanism increases bacterial content, oxygen demand, production of algal growth factors, and algal growth; extent of eutrophication is also indicated by lime precipitation during summer stagnation. With adequate decrease in phosphate addition, basic value of phosphate will decrease. After many years, smaller quantities of phosphates will be offered to algae before the beginning of the vegetative period, and the trophic content of the lake will approximate its original state. (See also W70-03975). (Jones-Wisconsin)
W70-07266

ASIAN LAKES,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
Shoji Horie.
Eutrophication: Causes, Consequences, Correctives, p 98-123. Printing and Publishing Office, National Academy of Sciences, Washington, D.C., 1969. 11 fig, 8 tab, 40 ref.

Descriptors: *Lakes, Eutrophication, Chemical analysis, Benthic fauna, Physicochemical properties, Nitrogen, Diatoms, Dissolved oxygen, Hydrogen sulfide, Rooted aquatic plants, Salmon, Daphnia, Crustaceans, Tubificids, Scenedesmus, Euglena, Cyanophyta, Water pollution effects.
Identifiers: *Asia, Japanese lakes, Lake Suwa-ka (Japan), Lake Haruna-ko (Japan), Lake Yogo-ko (Japan), Lake Biwa-ko (Japan), Lake Kizaki-ko (Japan), Zizania, Phragmites, Potamogeton, Vallisneria, Stephanodiscus, Brachionus, Moina, Closterium, Manchuria, Pediastrum, China, Lamprocystis, Cyclops, Spirulina.

Asian limnology, with the exception of Japan's, has not been studied to a great extent. A distinction is made between global eutrophication--the result of climatic change, and local eutrophication--based on earth movements. Differences in Asian limnology from European and North American are described. Physicochemical properties and plant successions of five Japanese lakes are discussed. In Manchuria, the Brachionus urceus-Daphnia magna appears in polluted waters, with Daphnia carinata and Moina macrocopa where pollution is less severe. Northern mainland Chinese lakes are astatic, scattered in the flood plains of the loess region along the River Huang; they are heavily polluted, become increasingly eutrophic, and finally disharmonic. In developmental history of ancient Japanese lakes, all of which appear harmonic, oligotrophy and eutrophy apparently alternated. Following the classification of Sladecek, increased pollution causes the transition from Limnosaprobitat to Isosaprobitat, when the water contains no dissolved oxygen but a small amount of hydrogen sulfide. Indicative organisms are given. When pollution accumulates past the lake's buffering capacity, it causes a change to Eusaprobitat, accelerating formation of sapropel step by step toward Hypersaprobitat--a process termed sapropellization. (See also W70-03975) (Auen-Wisconsin)
W70-07273

STUDIES ON THE VEGETATION AND HYDROCHEMISTRY OF SCANIAN LAKES I-II,
Artur Almestrand, and Asta Lundh.
Lunds Botaniska Forening, Botaniska Notiser, Supl Vol 2, No 3, p 1-174, 1951. 55 fig, 17 tab, 140 ref.

Descriptors: *Aquatic plants, *Water chemistry, *Ions, *Lakes, Geology, Chemical properties, Physical properties, Bottom sediments, Hydrologic properties, Meteorological data, Vegetation, Distribution, Water chemistry, Sewage, Outlets, Depth, Sea level, Rainfall, Soils, Calcium, Phosphate, Potassium, Temperature, Color, Turbidity, Light penetration, Water level fluctuations, Diatoms, Crustaceans, Chara, Grasses, Iron, Humus, Mosses, Sampling, Hydrogen ion concentration, Manganese, Sewage, Conductivity, Potassium, Chlorides, Sulfates, Nitrates, Phosphorus, Bicarbonates.
Identifiers: *Scanian lakes (Sweden), Sweden, Potamogeton, Reeds, Gyttja, Nymphaeacea, Isoetes, Elodea, Silicic acid, Ceratophyllum.

The variations in flora and their contributing factors were studied in 31 Scanian lakes. Efforts were made to establish characteristic features of electrolyte concentrations and determine whether there is a correlation between ion concentrations and aquatic plant distribution. Ions studied were calcium, magnesium, iron, potassium, chlorine, sulphate, nitrate, phosphate, silicate and bicarbonate. Potassium permanganate consumption, pH, specific conductivity, total solids, non-volatile solids, total hardness and color were also analyzed. Methods are described. The most striking result is the variation in concentration of calcium and bicarbonate; concentrations of other ions more or less agree or the variation is heterogeneous. No apparent differences appear between lakes and aberrant vegetation from the values here given for potassium, phosphorus, and nitrate. The origin of the variant lake vegetation cannot be discovered from an investigation of this type as the salt concentration is only one factor of the large complex forming the environments. It gives no contribution to knowledge of true requirements of individual species. (Jones-Wisconsin)
W70-07275

BIOLOGICAL EFFECTS AND PERSISTENCE OF DURSBAN* IN FRESHWATER PONDS,
California Univ., Riverside. Dept of Entomology; and Bureau of Sport Fisheries and Wildlife, Davis, Calif.
Stuart H. Hurlbert, Mir S. Mulla, James O. Keith, William E. Westlake, and Margaret E. Dusch.
Journal of Economic Entomology, Vol 63, No 1, p 43-52, 1970. 7 tab, 29 ref.

Descriptors: *Insecticides, *Mosquitoes, Ponds, Mallard ducks, Fish, Zooplankton, California, Organophosphorous pesticides, Pesticide kinetics, Ducks.
Identifiers: *Dursban, Mosquitoes, Corisella, Bakersfield (Calif), Cholinesterase activity, Mosquito control.

Dursban (0,0-diethyl 0-3,5,6-trichloro-2 pyridyl phosphoro-thioate) was applied in quadruplicate at two week intervals to small freshwater ponds at rates of 0.01, 0.05, 0.10, and 1.0 lb per acre. The total mortality of mallard ducklings was 42% on treated ponds and zero on control ponds. The rate of application and the mortality of birds showed no relationship. Except for the highest rate of application, the insecticide caused less than 10% mortality of caged mosquito-fish. Fish exposed to 0.05 lb/acre treatment had Dursban residue of 0.1 ppm two weeks after application. Reduction of Corisella population was approximately proportional to the rate of treatment. Several zooplankton species were markedly affected by the insecticide applied at higher rates. The residue of the chemical in vegetation declined rapidly from 26 ppm after 4 hours to 1.1 ppm after 7 days. (Wilde-Wisconsin)
W70-07276

PRIMARY PRODUCTIVITY AND STANDING CROPS OF PHYTOPLANKTON IN BELWOOD RESERVOIR,
Waterloo Univ. (Ontario). Dept. of Biology.
Hamish C. Duthie, and William L. Kirton, Jr.
Canadian Journal of Botany, Vol 48, No 4, p 665-670, 1970. 3 fig, 1 tab, 8 ref.

Descriptors: *Primary productivity, *Reservoirs, *Phytoplankton, Inflow, Standing crop, Photosynthesis, Carbon, Thermal stratification, Productivity.
Identifiers: Activity coefficient, Carbon assimilation, Belwood Reservoir (Canada), Canada.

Primary production and growth features of standing crop recorded at the inflow and near the dam of the Belwood Reservoir, Ontario, are described. While the biomass of standing crop and the rate of assimilation of carbon per square meter were less at the inflow, the activity coefficient was higher than that near the dam. The coefficient varied from 0.19, in sites dominated by Cryptomonas, Asterionella, and Dinobryon, to 0.02, in locations with large population of Ceratium hirundinella. Stands of Peridinium aciculiferum had coefficient of 0.05. Standing crops and activity coefficient were inversely correlated. Estimates of daily production ranged from 134 to 1650 milligram carbon per square meter. (Wilde-Wisconsin)
W70-07277

BENTHIC FAUNA COLONIZATION OF A NEW RESERVOIR WITH PARTICULAR REFERENCE TO THE CHIRONOMIDAE,
Waterloo Univ. (Ontario). Dept. of Biology.
C. G. Paterson, and C. H. Fernando.
Journal of the Fisheries Research Board of Canada, Vol 27, No 2, p 213-232, 1970. 7 fig, 4 tab, 24 ref.

Descriptors: *Reservoirs, *Impoundments, *Benthic fauna, Succession, Dissolved oxygen, Temperature, Sedimentation, Decomposing organic matter.
Identifiers: *New reservoirs, Chironomidae, Specific conductance, Laurel Creek Reservoir (Ontario), Canada, Colonization.

Two months after filling the Laural Creek Reservoir (Ontario), submerged terrestrial and rheophilic organisms were largely replaced by limnophilic species. By the fourth month the fauna was dominated by euryoxybiontic limnophiles and by facultative species. In the autumn, the fauna consisted largely of polyoxybiontic chironomids, and alteration coinciding with siltation and decomposition of organic matter. During the second summer, most of euryoxybiontic chironomids were replaced by polyoxybiontic forms. The facultative species of the creek fauna were not influenced by the modifications of the reservoir habitat. (Wilde-Wisconsin)
W70-07279

SUPERSATURATION OF LAKE WATER WITH A PRECAUTION TO HATCHERY USAGE,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-07310

METEOROLOGICAL RECORDS FOR LAKESIDE, 1968 AND 1969.
State Univ. Coll., Fredonia, N.Y.
For primary bibliographic entry see Field 02B.
W70-07345

RESEARCH TO SAVE AMERICA'S LAKES,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
For primary bibliographic entry see Field 05C.
W70-07393

VERTICAL MIGRATION OF ZOOPLANKTON IN WESTERN LAKE SUPERIOR,
Minnesota Univ., Duluth.
For primary bibliographic entry see Field 05C.
W70-07510

2I. Water in Plants

EVALUATION OF SOIL-APPLIED HERBICIDES FOR VEGETATION CONTROL,
Bureau of Reclamation, Denver, Colo. Office of Assistant Commissioner and Chief Engineer.
For primary bibliographic entry see Field 04A.
W70-07231

AQUATIC BIOLOGY ABSTRACTS, 1969.
For primary bibliographic entry see Field 10.
W70-07370

2J. Erosion and Sedimentation

PLAN AND PROFILE CHARACTERISTICS OF BEACHES IN THE CANADIAN ARCTIC ARCHIPELAGO,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 02C.
W70-07152

HIGH-MAGNESIAN CALCITE AND PROTODOLOMITE IN LAKE BALATON (HUNGARY) SEDIMENTS,
Heidelberg Univ. (West Germany). Sediment Research Lab.
German Muller.
Nature, Vol 226, No 5247, p 749-750, May 23, 1970. 2 p, 2 fig, 5 ref.

Descriptors: *Chemical precipitation, *Lakes, *Sedimentation, *Calcite, *Dolomite, Evaporation, Water balance, Water chemistry, Solutes, Aqueous solutions, Mineralogy.
Identifiers: *Lake Balaton (Hungary).

Recent sedimentation in Lake Balaton, Hungary, is governed chiefly by two processes: (a) Clastic material (quartz, feldspars, calcite, dolomite, phyllosilicates, heavy minerals) introduced by wind and rivers is distributed on the bed by the currents; (b) during the warmer seasons much fine-grained high-magnesian calcite is precipitated from the lake because of the dense and extensive growth of phytoplankton. In photosynthesis carbon dioxide is liberated from dissolved bicarbonate, and carbonate is precipitated. In addition to the clastic dolomite (stoichiometric dolomite), which occurs mainly in the coarse silt, and sand fractions of all sediments, authigenic protodolomite has been detected in the clay fraction of most of the bottom muds. (Knapp-USGS)
W70-07153

SAND WAVES: CAPE HATTERAS, NORTH CAROLINA,
Virginia Univ., Charlottesville.
For primary bibliographic entry see Field 02L.
W70-07154

ORIGIN, CLASSIFICATION, AND GEOLOGIC HISTORY OF CALICHE ON THE SOUTHERN HIGH PLAINS, TEXAS AND EASTERN NEW MEXICO,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
C. C. Reeves, Jr.
Journal of Geology, Vol 78, No 3, p 352-362, May 1970. 11 p, 1 fig, 3 plate, 45 ref.

Descriptors: *Caliche, *Texas, *Soil water movement, *Chemical precipitation, Calcareous soils, Arid lands, Loess, Carbonate rocks, Clays, Hardpan, Soil types, Infiltration, Calcium carbonate, Permeability, Water chemistry, Groundwater movement, Evaporation.
Identifiers: Southern High Plains (Texas).

The caliche profiles on the southern High Plains, Texas and eastern New Mexico, are of Pliocene, Pleistocene, and Holocene age. Differences in age, physical factors, and chemistry allow classification of the caliche into young, mature, and old types. Young caliche is incompetent and powdery except when formed as a laminated zone over an underlying plugged profile. Mature caliche is characteristically nodular, grading downward into old caliche which contains diagenetic quartz. Massive caliches form on semiarid, rapidly aggrading, flat surface of desert loess, on thick calcareous sands providing local climate fluctuates between humid and semiarid, and on near-surface carbonate rocks. The base and sequential development of the caliche are determined by extent and amount of infiltration of water during humid periods following accumulation of calcareous loess, by permeability of the parent material, and by the rapidity of plugging in the caliche profile. Caliche anticlines, or expansion structures, form only in mature caliche or preexisting carbonates. They are formed by expansion of the entire zone caused by filling of horizontal and vertical desiccation cracks by vadose silt and calcareous dripstone. The most intense expansion structures form on interbedded lacustrine clays and sands. Induration of the upper part of a thick caliche results mainly from exposure. Induration of the lower part of the profile included the deposition of diagenetic quartz and carbonate. (Knapp-USGS)
W70-07158

THE AVALANCHING OF GRANULAR SOLIDS ON DUNE AND SIMILAR SLOPES,
Reading Univ. (England). Sedimentology Research Lab.
J. R. L. Allen.
Journal of Geology, Vol 78, No 3, p 326-351, May 1970. 26 p, 10 fig, 3 tab, 24 ref.

Descriptors: *Sediment transport, *Sliding, *Dunes, *Slopes, Friction, Movement, Avalanches, Landslides, Debris avalanches, Mass wasting, Sedimentary structures, Topography, Model studies, Geomorphology, Deltas, Particle size, Particle shape, Talus.
Identifiers: Scree.

Avalanching occurs on slopes underlain by loose granular solids, for example, the slip faces of dunes and deltas and mountain screes, in response to a particle deposition-rate gradient which steepens these slopes to states of instability. The frequency, size, and behavior of the avalanches thus released are shown theoretically to depend on the particle deposition-rate gradient, the particle concentration at the time of deposition, the particle size and density, and the avalanching medium. Experiments made under simplified conditions using natural sands, glass beads, and natural grains provide satisfactory confirmation of major features of the theory. The results are significant for the interpretation of sedimentary structure and landscape form and are consistent with the properties of avalanches observed from experimental sand dunes and mountain screes. (Knapp-USGS)
W70-07160

TIDAL FLAT SEDIMENTATION AT COOLEY LANDING, S. W. SAN FRANCISCO BAY,
San Francisco State Coll., Calif. Dept. of Geology.
For primary bibliographic entry see Field 02L.
W70-07163

INVESTIGATION OF THE DUNE MOVEMENT OF SEDIMENTS ON THE POLOMET RIVER,
Yu. M. Korchokha.
Transl. of Trudy Gos. Gidrol. Institute, No 161, p 98-121, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 541-559, 1968. 8 fig, 7 tab, 33 ref, append.

Descriptors: *Dunes, *Bottom sediments, *Rivers, Flow rates, Waves (Water), Slopes, Sedimentary structures, Hydraulic properties, Streams, Velocity, Sands, Particle size, Channels.
Identifiers: *USSR, *Polomet River, Dune movements.

River-bottom sediments move under the dynamic effect of flow and this movement is accompanied by wavelike bottom deformations. Dune movement of sediments is most clearly represented on the upper slope of a bar. The rate of dune movement is directly proportional to the stream velocity and sediment diameter, and inversely proportional to dune height. The movement of sand dunes is of pulsating nature. The pulsations are produced by large-scale fluctuations in stream velocities. The presence of structural eddy formation that develops in the dune troughs and appears at the surface over the crest of the next dune is a characteristic phenomenon in the Polomet River, USSR. (Carstea-USGS)
W70-07200

THE NATURE AND ORIGIN OF BED-FORM HIERARCHIES,
Reading Univ. (England), Sedimentology Research Lab.
J. R. L. Allen.
Sedimentology, Vol 10, No 3, p 161-182, April 1968. 22 p, 11 fig, 2 tab, 67 ref.

Descriptors: *Sedimentary structures, *Channel morphology, *Alluvial channels, Sediments, Bottom sediments, Open channel flow, Dunes, Ripple marks, Deposition (Sediments), Streamflow, Sediment transport.
Identifiers: Bed-form hierarchies.

The bed forms generated by liquid flows over loose-grain boundaries assume only 2 orientations relative to flow, either transverse or longitudinal, but range enormously in physical scale. Two types of bed form, current ripples and parting lineations, take a characteristic length which is independent of boundary conditions as expressed by flow depth. The characteristic length of other kinds of bed form is correlated with flow depth, according to given equations. From these relationships can be deduced the compositions of theoretical hierarchies of bed forms, where a hierarchy is defined as a series of bed forms graded as to size which in combination are adapted to a single overall flow condition. The compositions of these hierarchies, which are closely matched by naturally occurring hierarchies, are broadly related to available flow depth, general flow conditions (lower or upper regime), and availability of sediment. Bed forms are considered to be due to unstable interactions between the bed material and the over-bed flow of liquid or grains, or both. Hierarchies of bed forms arise because the quantities determining the flow are sufficiently numerous that several mutually unstable combinations can exist, each combination being expressed in terms of a bed form of a characteristic physical scale and orientation relative to flow. (Knapp-USGS)
W70-07211

POSSIBLE SIGNIFICANCE OS TRANSITION FLOW PATTERNS IN INTERPRETATION OF ORIGIN OF SOME NATURAL BED FORMS,
Geological Survey of Israel, Jerusalem.
Iaakov Karcz.
Journal of Geophysical Research, Vol 75, No 15, p 2869-2873, May 20, 1970. 5 p, 36 ref.

Descriptors: *Sediment transport, *Sedimentary structures, *Channel morphology, *Regime, Streamflow, Transition flow, Turbulent flow, Turbulence, Vortices, Eddies, Laminar flow.
Identifiers: Bed forms.

A similarity in morphology and sequence of development seems to exist between some common sedimentary structures and flow configurations encountered in transition and generation of turbulence. The question arises whether such flow instability patterns determine the embryonic configurations of bed deformation, which subsequently develop and grow, thus triggering the appearance of finite size natural bed forms. In the early stage of transition in boundary layer flow over a flat rigid plate, weak, predominantly two-dimensional disturbances appear and are selectively amplified, growing into a pronounced two-dimensional wave pattern. The appearance and the increasing effect of three-dimensional disturbances within the flow result in a regular spanwise distortion of the wave pattern and a corresponding shift in the vorticity alignment, which lead to a fully three-dimensional configuration of flow. Natural, experimentally produced ripples occur in two-dimensional and three-dimensional patterns related respectively to lower and higher energy flows. The embryonic patterns in the higher energy flows, as well as transient ripple patterns (encountered before equilibrium is attained in flows corresponding to a higher stage of flow regime) are basically two dimensional, with some superimposed seminal three-dimensional elements that grow preferentially until the entire pattern becomes three dimensional. (Knapp-USGS)
W70-07352

THE HYPERBOLIC DISTRIBUTION OF PARTICLE SIZES,
Miami Univ., Fla. Inst. of Marine and Atomospheric Sciences.
Henri Bader.
Journal of Geophysical Research, Vol 75, No 15, p 2822-2830, May 20, 1970. 9 p, 9 fig, 4 ref, append.
NONR Grant 4008 (02) 7 (UM7892).

Descriptors: *Particle size, *Mathematical studies, Dusts, Sediments, Grading, Histograms, Suspended load, Suspension, Sedimentology, Turbidity.
Identifiers: Hyperbolic size-distribution.

Many natural collections of small particles, such as cosmic and terrestrial dust, mineral and organic particles suspended in sea water, and fine sediments, have a size distribution well formulated by equations describing hyperbolas. A number of equations are derived for calculating the interesting parameters characterizing hyperbolic distribution, illustrated by new Coulter Counter measurements of dust and sea water. An appendix lists useful equations, generalized for different size parameters. (Knapp-USGS)
W70-07355

AN EXPERIMENTAL INVESTIGATION OF THE VERTICAL MASS TRANSFER OF SUSPENDED SEDIMENT,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Harvey E. Jobson, and William W. Sayre.
In: Proceedings 13th Congress of the International Association of Hydraulic Research, Aug 31-Sept 5, 1969, Vol 2, Subject B, p 111-120, 1969. 10 p, 4 fig, 5 ref.

Descriptors: *Sediment transport, *Suspended load, *Mass transfer, *Hydraulic models, Turbulence, Sands, Silts, Sampling, Settling velocity, Flumes, Suspension, Sediment load.
Identifiers: Turbulent mass transfer.

Vertical turbulent mass transfer coefficients and effective fall velocities for suspended sand particles were determined experimentally in a large laboratory flume by equating the net rate of sediment transfer across planes parallel to the water surface with the longitudinal gradient of sediment flux in the direction of flow, contained in the region bounded by the water surface and the selected planes. The vertical turbulent mass transfer coefficient for fine sand is fairly close in magnitude and distribution to both the mass transfer coefficient for a neutrally buoyant liquid and the momentum transfer coefficient. The mass transfer coefficient for medium sand is somewhat less in magnitude and its distribution is weighted heavily toward the bed. The fall velocity of sand particles is larger in turbulent channel flow than in quiescent water, with the difference more pronounced for the fine than for the medium particles. (Knapp-USGS)
W70-07369

HOT BRINES AND RECENT HEAVY METAL DEPOSITS IN THE RED SEA,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02K.
W70-07394

CHANGES IN NATURAL CHANNELS DOWNSTREAM FROM MAN-MADE RESERVOIRS,
Mississippi State Univ., State College. Dept. of Civil Engineering.
Adnan Shindala, and Melville S. Priest.
Completion Report, April, 1970. 16 p. OWRR Project A-030-MISS (3).

Descriptors: *Degradation (Stream), *Dams, *Stream erosion, Sediment load, Sediment transport, Scour.
Identifiers: *Channel degradation, Scour forecasting.

In general, the study was an anlysis of prototype data for the purpose of determining channel changes downstream from man-made control structures. One part of the study was devoted to changes which occurred in the main stream as a result of man's deliberate alteration of conditions in the upper reaches of a small drainage basin. A second, and more comprehensive, part of the study was devoted to channel changes immediately downstream from very large man-made reservoirs. There has been intense activity in the construction of dams and other control structures in some of the small drainage basins of Mississippi. Some of the changes in the main stream of one such basin were determined from data supplied by several interested federal agencies. As might have been anticipated, peak discharges were somewhat reduced. Changes in cross-section of the main channel depended upon location along the stream. There was a narrowing of the channel in that portion of the stream for which cross-sections were available. Data on channel degradation downstream from large reservoirs were supplied by the Bureau of Reclamation and the Corps of Engineers. Analyses of the data resulted in methods for prediction of the ultimate degradation near the dam, the time required for ultimate degradation near the dam and the distance downstream from the dam to the limit of ultimate degradation. This report consists of four technical papers through which the results of the study have been published. (See also W69-09491 and W70-07520 thru W70-07522).
W70-07519

CHANNEL DEGRADATION DOWNSTREAM FROM LARGE DAMS,
Mississippi State Univ., State College. Water Resources Research Inst.; and Mississippi State Univ., State College. Dept. of Civil Engineering.
Melville S. Priest, and Adnan Shindala.
Water Power, Vol 21, No 11, p 436-437, November 1969. 2 p, 1 fig, 2 ref. OWRR Project No A-030-MISS (3).

Descriptors: *Stream erosion, *Scour, *Dams, *Degradation (Stream), Sediment load, Particle size, Discharge (Water), Streamflow, Bed load, Suspended load, Sediment yield.
Identifiers: *Scour forecasting.

The creation of a large reservoir by obstructing the flow of a natural stream with a dam tends to upset the normal relation between the stream and its channel. If the stream loses a significant sediment load in the relatively quiet waters of a newly created reservoir, it is expected that the stream will react by eroding the channel for some distance downstream from the dam. A practical solution should be possible through analysis of prototype data. Prototype data suitable for analysis seem to be few. However, there are sufficient data available to indicate trends. In order to arrive at a useful solution it is necessary to describe the initial bed materials. This is done from size analyses of the bed materials. Knowing the plan for future release of water from the reservoir and the initial analysis of bed materials, the initial channel cross-section, and the initial stage-discharge relation, the relation given provides a simple means for evaluating the ultimate degradation or lowering of the channel bottom. (See also W70-07519). (Knapp-USGS)
W70-07520

TIME REQUIRED FOR ULTIMATE CHANNEL DEGRADATION DOWNSTREAM FROM LARGE DAMS,
Mississippi State Univ., State College. Water Resources Research Inst.; and Mississippi State Univ., State College. Dept. of Civil Engineering.
Melville S. Priest, and Adnan Shindala.
Water Power, Vol 21, No 12, p 472-473, December 1969. 2 p, 3 fig, 3 ref. OWRR Project No A-030-MISS (3).

Descriptors: *Stream erosion, *Scour, *Dams, *Degradation (Stream), Sediment load, Particle size, Discharge (Water), Streamflow, Bed load, Suspended load, Sediment yield.
Identifiers: Scour forecasting.

An analysis is presented which enables the prediction of time required for ultimate channel degradation downstream of a new reservoir. A qualitative treatment of the time rate of degradation for a reach and the variation in time for ultimate degradation along the channel may be calculated. The physical quantities which appear to be sufficient for an analysis of time for ultimate degradation at a section such as that described in the first paragraph are the ultimate degradation or change in average bottom elevation; the initial grain diameter of bed materials at 50% finer; the initial variation in grain size as described by the standard deviation from diameter between 10 and 90% finer; the average depth of flow through the initial cross-section for the projected average of annual peak values of monthly average discharges; and the acceleration of gravity. (See also W70-07519). (Knapp-USGS)
W70-07521

DISTANCE DOWNSTREAM FROM A LARGE DAM TO THE LIMIT OF ULTIMATE CHANNEL DEGRADATION,
Mississippi State Univ., State College. Water Resources Research Inst.; and Mississippi State Univ., State College. Dept. of Civil Engineering.
Melville S. Priest, and Adnan Shindala.
Proceedings 13th Congress of the International Association for Hydraulic Research Vol 5-1 Kyoto, Japan, September 1969, p 241-243, 1969. 3 p, 1 fig. OWRR Project A-030-MISS (3).

Descriptors: *Stream erosion, *Scour, *Dams, *Degradation (Stream), Sediment load, Particle size, Discharge (Water), Streamflow, Bed load, Suspended load, Sediment yield.
Identifiers: Scour forecasting.

The passage of a sediment-laden stream through a large reservoir may result in velocities so low that virtually all of the stream's sediment load is lost within the reservoir. The release of such sediment-free water from a newly created, man-made reservoir will result in degradation or lowering of the natural channel for some distance downstream from the dam. A method is given for prediction of the distance downstream from the dam to the limit of ultimate channel degradation. The method of prediction proposed is based upon an analysis of prototype data. The physical quantities which are of direct use are the ultimate degradation at a section near the dam, but sufficiently far from it that the flow characteristics are more or less those of a natural stream; the standard deviation of initial bed grain diameter between 10 percent and 90 percent finer from the grain diameter at 50 percent finer, at the same section; and the initial average depth at the same section, for a projected discharge that is the average of annual peak values of monthly averages over a period sufficiently long after closure to allow the limits of ultimate degradation to occur. (Knapp-USGS)
W70-07522

2K. Chemical Processes

ORIGIN, CLASSIFICATION, AND GEOLOGIC HISTORY OF CALICHE ON THE SOUTHERN HIGH PLAINS, TEXAS AND EASTERN NEW MEXICO,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
For primary bibliographic entry see Field 02J.
W70-07158

PHYSICOCHEMICAL CONDITIONS OF FORMATION OF NATIVE ARSENIC IN HYDROTHERMAL DEPOSITS,
Akademiya Nauk SSSR, Moscow. Inst. of Geochemistry.
E. I. Sergeyeva, and I. L. Khodakovskiy.
Transl. from Geokhimiya, No 7, p 846-859, 1969. Geochemistry International, Vol 1969, no 7-8, p 681-694, April 1970. 5 fig, 4 tab, 52 ref.

Descriptors: *Water chemistry, *Chemical precipitation, *Thermal water, *Arsenic compounds, Mineralogy, Geology, Chemical reactions, Thermodynamics.
Identifiers: Hydrothermal deposition, USSR.

According to the Eh - pH diagrams calculated for the system As - H2 O for temperatures of 25, 100, and 200 deg C, separation of native arsenic from hydrothermal solutions is possible only at temperatures below 200 deg C, if the concentration of ar-

senic in the solution is very low, and in the presence of strong reducing agents. The most probable form in which arsenic exists in the hydrothermal solutions is arsenious acid. (Knapp-USGS)
W70-07169

HIGHLY ALKALINE (pH 12) FLUOSILICATE WATERS IN THE DEEPER ZONES OF THE LOVOZERO MASSIF,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
S. R. Kraynov, A. N. Mer'kov, N. G. Petrova, I. V. Baturinskaya, and V. M. Zharikova.
Transl. from Geokhimiya, No 7, p 791-796, 1969. Geochemistry International, Vol 1969, No 7-8, p 635-640, April 1970. 3 fig, 2 tab, 6 ref.

Descriptors: *Water chemistry, *Geochemistry, *Groundwater, Fluorides, Silica, Mine water, Mineralogy, Analytical techniques.
Identifiers: *Lovozero Massif (USSR), Villiaumite.

Groundwaters in the deep zones of the Lovozero alkalic massif are highly alkaline (pH 12) and strongly enriched in fluorine (up to 10-15 g/liter and silica (up to 10-13 g/liter. These waters form as a result of solution of villiaumite (NaF), an abundant mineral in the rocks of the massif. They also contain rather large amounts of aluminum, titanium, niobium, copper, and some other elements. Though the high fluoride content of these waters can be explained by the solution of villiaumite, the high alkalinity and silica, coupled with relatively low carbonate, are most readily attributed to dissolution of primary silicates (principally nepheline) in the absence of atmospheric carbon dioxide. (Knapp-USGS)
W70-07170

SOME PROPERTIES OF WATER AT ELEVATED PRESSURES AND TEMPERATURES,
I. G. Ganeyev, and V. N. Rumyantsev.
Transl. from Geokhimiya, No 7, p 881-890, 1969. Geochemistry International, Vol 1969, No 7-8, p 708-717, April 1970. 8 fig, 30 ref.

Descriptors: *Water properties, *Aqueous solutions, Solutes, Electrolytes, Mineralogy, Water temperature, Water pressure, Quartz, Water chemistry, Solubility, Vapor pressure, Viscosity, Density, Geochemistry.
Identifiers: USSR.

Analysis of published data shows that at elevated pressures and temperatures, density is the principal factor determining the degree of dissociation of water and consequently, the solubility of such difficulty soluble minerals and compounds as silica, aluminum oxide, and others, and of strong electrolytes. The dissociation of strong electrolytes is intimately related to the magnitude of the dielectric constant of water. The mechanism of solution of difficult soluble minerals and compounds in water at elevated pressures and temperatures is discussed with quartz as an example. (Knapp-USGS)
W70-07171

SIMULTANEOUS DETERMINATION OF CARBON AND OXIDABILITY OF ORGANIC COMPOUNDS IN NATURAL WATERS,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
Ye. I. Perel'shteyn, and V. T. Kaplin.
Transl. from Gidrokhimicheskiye Materialy, Vol 46, p 178-181, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 660-663, 1968. 1 fig, 1 tab, 12 ref.

Descriptors: *Analytical techniques, *Organic compounds, *Water quality, Carbon, Ammonium salts, Organic matter, Water analysis.
Identifiers: Ammonium (Potassium) persulfate, Oxidizer.

The determination of organic carbon and oxidability from a single water sample by using ammonium (potassium) persulfate as an oxidizer is described in detail. The sensitivity of the proposed method for determining carbon is 0.5 mg carbon per liter. The accuracy of the method averages 5% for organic carbon and 7-10%, for oxidability. The shortcomings of the most common methods used for determining the oxidability of organic matter in natural waters are also briefly given. (Carstea-USGS)
W70-07201

COMPOSITION OF ORGANIC SUBSTANCES IN THE WATERS OF RESERVOIRS AND LAKES,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
A. D. Semenov, L. I. Nemtseva, T. S. Kishkinova, and A. P. Pashanova.
Transl. from Gidrokhimicheskiye Materialy Vol 46, p 79-84, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 656-660, 1968. 1 tab, 16 ref.

Descriptors: *Water chemistry, *Organic compounds, *Reservoirs, *Lakes, Water quality, Carbohydrates, Aquatic environment, Organic acids, Amino acids, Proteins.
Identifiers: *USSR, Amines, Sugars.

The organic carbon contents of the Rybinsk, Kakhova, Bratsk, Dubossary, and Samgora Reservoirs, and Lakes Baykal, Onega, and Sevan, USSR, were determined in 1965. The total content of nonvolatile organic substances in the investigated water samples of lakes and reservoirs varies in the range 5-60 mg/liter and in each of the water bodies can vary to a greater degree than the total concentration of inorganic substances. The concentration of free amino acids, amines and protein substances is 0.01-0.08, 0.02-0.08 and 0. 3-0. 6 mg/liter respectively. In the composition of substances containing nitrogen the compounds of nonprotein nature predominate. The relatively high content of organic acids (0.06-0. 3 mg equiv/liter) makes it possible to postulate that they play an important role (as do some substances containing nitrogen) in the distribution of forms of migration of microelements, particularly the transition metals. The relation between the concentrations of reducing sugars and complex carbohydrates (polysaccharides) in the water of reservoirs and lakes differs sharply from that in water plant organisms.
W70-07202

FACTORS AFFECTING THE FLUORINE CONTENT IN NATURAL WATERS,
Ye. A. Gel'fer.
Transl. from Gidrokhimiya Materialy Vol 46, p 74-78, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 652-656, 1968. 3 tab, 9 ref.

Descriptors: *Water quality, *Fluorine, *Fluorides, Calcium compounds, Ions, Sulfates, Carbonates, Soils, Carbon dioxide, Calcium Carbonate, Calcareous soils, Magnesium, Sodium, Potassium.
Identifiers: *USSR.

Calcium salts suppress the extraction of fluorine from water-bearing rocks, whereas magnesium salts favor the more complete extraction of fluorine. Increased concentrations of sulfates, Mg, Na, and K in natural water favor enrichment of water with fluorine. The fluorine content in waters whose chemical composition has been modified by human economic activity depends upon the carbonate content of soils and the rocks underlying them as well as on the carbonic acid regime. Carbonic acid dissolves calcium carbonate, and the resulting calcium ions form nearly immobile calcium fluoride by reactions with fluorides. The holding capacity of calcareous soils is often relatively great. (Carstea-USGS)
W70-07204

FACTORS FORMING THE CHEMICAL COMPOSITION OF PRECIPITATION,
Politekhnicheskii Institut, Novocherkassk (USSR).
Ye. V. Posokhov.
Transl. from Gidrokhimicheskiye Materialy, Vol 46, p 15-31, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 640-652, 1968. 62 ref.

Descriptors: *Precipitation (Atmospheric), *Rainfall, *Water chemistry, Water quality, Chemical properties, Precipitable water, Rainfall-runoff relationships, Soils, Orography, Meteorological data, Vegetation effects.
Identifiers: *USSR.

The chemical composition of precipitation is affected by the simultaneous influence of sea, soil, geological, cosmic, orographic, climatic, meteorological, physicochemical, physical and biological factors. However, the relations of these factors are variable. Over the continents, the chemical composition of precipitation is determined by the composition of soils and rocks, presence or absence of vegetation, and by meteorological and orographic factors. The aerosols suspended in the air in coastal regions are of continental-marine origin. Examples-describing the relative importance of different factors upon the chemical composition of precipitation are listed. (Carstea-USGS)
W70-07206

CHEMICAL QUALITY OF RIVER WATERS IN THE NORTHEASTERN USSR,
A. P. Uryvayev.
Transl. from Trudy DVNIGMI, No 26, p 84-94, 1968. Soviet Hydrology: Selected Papers, Issue no 6, p 631-640, 1968. 10p, 2 fig, 5 tab, 5 ref.

Descriptors: *Water chemistry, *Water quality, *Chemical properties, Hardness (Water), Organic compounds, Iron, Calcium, Magnesium, Nitrates, Nitrites.
Identifiers: *Northeastern USSR, Corrosive properties.

Total dissolved solids, water hardness, corrosive properties of water, organic and biogenic substances in water of the northeastern part of the USSR were surveyed. Total dissolved solids does not exceed 200 mg/liter. The relationship between hardness and the total iron, calcium, and magnesium cations is expressed mathematically, but is not valid when the total dissolved solids is below 70 mg/liter and iron content is large. Even a relatively small natural content of iron in surface waters limits their use in many types of activities, ranging from food industry to fisheries. The amount of iron ranged from 0.00 to 10.0 mg/liter. The nitrite ion content in the river water of the northeast was found to be equal to 0.000 - 0.004 mg/liter and only rarely reached values as high as 0.012 mg/liter. The maximum quantity of nitrates was observed during the winter low water, and sometimes during summer low water. (Carstea-USGS)
W70-07208

QUANTITATIVE RELATIONSHIPS BETWEEN MINERALIZATION AND CHEMICAL COMPOSITION OF RIVER WATER IN THE NORTHEASTERN USSR,
A. P. Uryvayev.
Transl. from Trudy DVNIGMI, No 26, p 78-83, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 626-631, 1968. 2 fig, 1 tab, 3 ref.

Descriptors: *Water chemistry, *Water quality, *Chemical properties, Rivers, Dissolved solids, Discharge (Water), High water mark, Meteorological data, Bicarbonates, Ions.
Identifiers: *USSR.

The relationships between mineralization and water discharge of USSR rivers are shown by plotting chemical analysis data against water discharge. In individual years, the curves showing the dependence between mineralization and

discharge have a hyperbolic or complex loop shape. A hyperbolic type of relationship is characteristic of the largest rivers, in which the changes in discharge are smallest. Loop-shaped curves are related to high-water periods. The duration of the periods between high water, and the meteorological conditions during the warm season govern the shape and number of loops. The relationships between the principal compounds of water and mineralization of river waters in the northeast USSR are poorly expressed. Close relationship was noted between mineralization and bicarbonate ion in rivers with primarily bicarbonate-type water. (Carstea-USGS)
W70-07209

ARGON 37, ARGON 39, AND KRYPTON 81 IN THE ATMOSPHERE AND TRACER STUDIES BASED ON THESE ISOTOPES,
Bern Univ. (Switzerland). Physikalisches Institut.
H. H. Loosli, H. Oeschger, and W. Wiest.
Journal of Geophysical Research, Vol 75, No 15, p 2895-2900, May 20, 1970. 6 p, 1 fig, 1 tab, 17 ref.

Descriptors: *Radioisotopes, *Tracers, *Gases, *Atmosphere, *Hydrologic cycle, Argon, Path of pollutants, Air circulation, Groundwater, Surface waters, Groundwater movement, Streamflow, Precipitation (Atmospheric).
Identifiers: Krypton.

Results of monthly measurements of the tropospheric Ar-37 activity during 1969, as well as measurements of the atmospheric activities of the recently detected isotopes Ar-39 and Kr-81 are presented. Applications of these isotopes for tracer studies in the atmosphere and in water reservoirs, for the determination of production rates, and for studying the constancy of the cosmic radiation flux are discussed. (Knapp-USGS)
W70-07248

CONTRIBUTION TO THE RESIDENCE TIME OF SULFUR DIOXIDE IN A POLLUTED ATMOSPHERE,
Federal Board of Health, Berlin (West Germany). Inst. of Water Soil, and Atmospheric Hygiene.
For primary bibliographic entry see Field 05B.
W70-07333

FREEZING TEMPERATURES OF WATER DROPLETS IN EQUILIBRIUM WITH DIFFERENT GASES,
Pennsylvania State Univ., University Park, Pa. Dept. of Meteorology.
For primary bibliographic entry see Field 02B.
W70-07335

TRACE ELEMENT CONCENTRATIONS IN THE TROPOSPHERE AND LOWER STRATOSPHERE.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
L. A. Rancitelli, and R. W. Perkins.
Journal of Geophysical Research, Vol 75, No 15, p 3055-3064, May 20, 1970. 10 p, 1 fig, 6 tab, 20 ref. AEC Contract AT (45-1)-1830.

Descriptors: *Trace elements, *Aerosols, *Sampling, *Data collections, *Distribution patterns, Air pollution, Dusts, Water pollution sources, Fallout, Sea water.
Identifiers: Air sampling.

A technique was developed and applied to establish the gradient of trace elements from the troposphere through the lower stratosphere. Aerosol collections were made over a two-year period at altitudes of 3 to 15 km between 37 deg N and 46 deg N. The concentrations of Ag, Co, Cr, Fe, Sb, Sc, and Zn measured by instrumental neutron-activation analysis showed gradients of 1-2 orders of magnitude over the altitude range. Concentrations at a given altitude varied as a function of time. A comparison of the relative concentrations observed in the atmosphere with those in metropolitan aerosols, the earth's crust, sea water, and rainwater collected at points remote from possible sources of pollution indicates that, although the atmospheric Fe, Co, and Sc are compatible with the injection of material from the earth's crust, the concentrations of Ag, Cr, Sb, and Zn in the atmosphere are too high to have originated from the natural sources considered. Of 19 elements measured in rainwater, it appears that the only elements that could originate primarily from the oceans are Na, Cl, and Br. (Knapp-USGS)
W70-07338

EVOLUTION OF THE ISOTOPIC COMPOSITION OF ATMOSPHERIC WATERS IN THE MEDITERRANEAN SEA AREA,
Weizmann Inst. of Science, Rehovot (Israel). Dept. of Isotope Research.
J. R. Gat, and I. Carmi.
Journal of Geophysical Research, Vol 75, No 15, p 3039-3048, May 20, 1970. 10 p, 10 fig, 20 ref.

Descriptors: *Stable isotopes, *Radioisotopes, *Tritium, *Precipitation (Atmospheric), Air masses, Climatology, Mass transfer, Winds, Synoptic analysis, Deuterium, Oxygen.
Identifiers: Mediterranean Sea, Oxygen isotopes.

The isotopic composition of rain in the Levant is a reflection of the modification of continental air masses by interaction with the warm Mediterranean Sea. The detailed pattern of evolution of Levantine air was studied by an isotopic survey of rain from 20 coastal and island stations in the eastern Mediterranean Sea area. The changes in tritium, deuterium, and oxygen 18 concentrations as a function of the distance from the coast usually differ from those calculated for a continuous air mass modification model. The major changes occur in the Aegean Sea and along the Turkish coast, in an area of major cyclogenesis. A model of convergent air masses, based on the synoptic patterns, is more consistent with the observed isotopic composition of atmospheric waters in the area. (Knapp-USGS)
W70-07339

INSTRUMENTAL ANALYSIS FOR TRACE ELEMENTS PRESENT IN CHICAGO AREA SURFACE AIR,
Argonne National Lab., Ill. Radiological Physics Div.
For primary bibliographic entry see Field 05A.
W70-07343

ATMOSPHERIC NITROUS OXIDE CONCENTRATIONS IN THE HUMID TROPICS,
National Center for Atmospheric Research, Boulder, Colo.
Miles D. LaHue, John B. Pate, and James P. Lodge, Jr.
Journal of Geophysical Research, Vol 75, No 15, p 2922-2926, May 20, 1970. 5 p, 3 fig, 5 ref. Army Research Office, Contract DAH C04-67-C-0024.

Descriptors: *Air pollution, *Nitrogen compounds, *Oxides, *Water pollution sources, *Tropical regions, Rain forests, Sampling, Data collections, Gas chromatography, Analytical techniques, Instrumentation.
Identifiers: Panama, Barbados.

Nitrous oxide concentrations were obtained from the atmosphere in and above the forests of Panama. Samples were also collected from the coasts of Panama and Barbados for comparison of nitrous oxide levels in Caribbean air with those levels in Atlantic air. Diurnal, climatic, and geographic differences are reported. The system used to collect and analyze the samples is modification of Schutz's method. Gas chromatographic Porapak columns were used in the analysis. (Knapp-USGS)
W70-07344

TRACE METAL CHARACTERIZATION IN AQUATIC ENVIRONMENTS BY ANODIC STRIPPING VOLTAMMETRY,
Bureau of Commercial Fisheries, Ann Arbor Mich., and Michigan Univ., Ann Arbor. Dept. of Environmental Health.
For primary bibliographic entry see Field 05A.
W70-07351

AUTOMATIC METHODS FOR DETERMINING NITRATE AND NITRITE IN WATER AND SOIL EXTRACTS,
Norsk Institutt for Vannforskning, Blindern; and Norges Landbrukshoegskole, Vollebekk.
For primary bibliographic entry see Field 05A.
W70-07358

QUALITY ASPECTS OF FARM WATER SUPPLIES.
Victorian Irrigation Research and Advisory Services Committee, Melbourne (Australia).
For primary bibliographic entry see Field 05G.
W70-07375

HOT BRINES AND RECENT HEAVY METAL DEPOSITS IN THE RED SEA,
Woods Hole Oceanographic Institution, Mass.
Egon T. Degens, and David A. Ross.
New York, Springer-Verlag New York Inc, 1969. 600 p.

Descriptors: *Brines, *Hot springs, *Bottom sediments, *Density stratification, *Mineralogy, Sampling, Sounding, Oceanography, Geochemistry, Geothermal studies, Water chemistry, Aqueous solutions, Saline water systems, Radioactive dating, Radiochemical analysis, Salts, Chemical precipitation, Saline water, Exploration.
Identifiers: *Red Sea, Hot brines.

In the rift valley of the Red Sea, oceanographers found a unique geochemical environment. Several years passed before the significance of the initial finds was fully appreciated. This area is characterized by the presence of hot and saline waters at the bottom of three deeps (water depth about 2,200 meters). Water temperatures are as high as 56 deg C and salinites reach 256 parts per thousand. The water and underlying sediment are generally devoid of any form of life. The sediments and the overlying brines contain abnormally high contents of iron, manganese, zinc, lead, copper, silver and gold. The value of these deposits exceeds 2 billion dollars. In studying this area insight may be gained on the origin of ancient ore deposits of hydrothermal and sedimentary origin. The editors have assembled over 50 papers on th different aspects of the hot brine problem. Chapters deal with regional structure and stratigraphy, local topography and rocks, geomagnetism and gravity, temperatures of water and sediments, movement of the water, chemistry of water and sediments, stable and radioactive isotopes, flora and fauna, comparison with ancient metalliferous strata, and economic and legal factors. (See also W70-07395 thru W70-07402). (Knapp-USGS)
W70-07394

HISTORY OF THE EXPLORATION OF THE HOT BRINE AREA OF THE RED SEA: DISCOVERY ACCOUNT,
National Inst. of Oceanography, Wormley (England).
J. C. Swallow.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 3-9, 1969. 7 p, 5 fig, 11 ref.

Descriptors: *Brines, *Saline water, *Density stratification, *Mineralogy, Sampling, Sounding, Oceanography, Hot springs, Geochemistry, Geothermal studies, Water chemistry, Aqueous solutions, Saline water systems, Salts, Solutes, Chemical precipitation, Bottom sediments, Exploration, Thermal stratification.
Identifiers: *Red Sea, Hot brines.

The RRS DISCOVERY, in exploring the hot brine pools of the Red Sea in 1964, delineated a small area (Discovery Deep) within which a brine with a temperature over 44 deg C was found. In addition, acoustic relecting layers were observed in mid-water in the brine areas during three passages through the Red Sea. These observations include layering in Atlantis II Deep, in November 1963, and a layer observed in April 1967 in a small depression to the south of the previously known brine area. The circumstances surrounding the DISCOVERY's observations and the observations themselves are outlined. (See also W70-07394). (Knapp-USGS)
W70-07395

THE OBSERVATIONS OF THE VERTICAL STRUCTURE OF HOT SALTY WATER BY R. V. METEOR,
G. Dietrich, and G. Krause.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 10-14, 1969. 5 p, 3 fig, 1 tab, 17 ref.

Descriptors: *Brines, *Saline water, *Density stratification, Thermal stratification, Sea water, Water chemistry, Sampling, Geochemistry, Saline water systems, Sounding.
Identifiers: *Red Sea, Hot brines.

On a cruise to the Indian Ocean, R. V. METEOR worked a section through the Red Sea with stations in several deep holes. Hot salty water occurred only in the Discovery Deep (st.28) and in the area of the Atlantic Deep (st.384). The upper limits of the abnormal water were indicated by sound-scattering layers. In both deeps continuous temperature and transparency measurements were carried out. At station 28 the temperature increased with depth within a thermocline of 45-m thickness from 21.6 deg C to 44.8 deg C. At station 384 three layers were observed; the temperature first increased from 21.6 deg C to 41.2 deg C, then to 57.7 deg C and finally to 58.4 deg C near the bottom. At both stations the water was found to be very turbid. The chemical properties of the water are described. (See also W70-07394). (Knapp-USGS)
W70-07396

ATLANTIS II ACCOUNT,
Woods Hole Oceanographic Institution, Mass.
Arthur R. Miller.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea, Springer-Verlag, New York, 1969, p 15-17. 3 p, 8 ref.

Descriptors: *Exploration, *Brines, *Water temperature, *Seawater, Oceanography, Sampling, Sediments, Saline water.
Identifiers: *Red Sea, Hot brines.

A brief account is given of the events leading to and occurring during the 1965 ATLANTIS II trip to the hot brine region of the Red Sea. (See also W70-07394). (Knapp-USGS)
W70-07397

TRACE ELEMENT COMPOSITION OF RED SEA GEOTHERMAL BRINE AND INTERSTITIAL WATER,
University of Southern California, Los Angeles. Inst. of Geophysics and Planetary Physics.
R. R. Brooks, I. R. Kaplan, and M. N. A. Peterson.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 180-203, 1969. 24 p, 7 fig, 4 tab, 14 ref. AEC Contract AT (11-1)34; Project 134.

Descriptors: *Brines, *Trace elements, *Water chemistry, *Hot springs, Sea water, Density stratification, Water analysis, Water temperature, Saline water, Geochemistry, Saline water systems, Chemical precipitation, Bottom sediments.
Identifiers: *Red Sea, Hot brines.

Analytical data are presented for concentration of Na, K, Ca, Mg, Li, Sr, Mn, Fe, Pb, Cu, Zn, Cd, Co and Ni in the brine of Atlantis II and Discovery Deeps and also the interstial water. Enrichment of alkali metals, Ca, Mn, Fe, Pb, Cu and Zn was found in the brine, and Mg was depleted relative to sea water. All metals were enriched in the interstitial water, with the exception of Mg and Fe. The base metals are much more enriched in the interstitial water than the brine. On the basis that trace metal enrichment is higher in brine and interstitial water samples from the Atlantis II Deep than from the Discovery Deep, it is suggested that the source of the brine is derived from beneath the floor at Atlantis II Deep. (See also W70-07394). (Knapp-USGS)
W70-07398

INVESTIGATIONS OF ATLANTIS II DEEP SAMPLES TAKEN BY THE FS METEOR,
Kiel Univ. (West Germany). Geological-Paleontological Inst.
Martin Hartmann.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 204-207, 1969. 4 p, 3 tab, 8 ref.

Descriptors: *Hot springs, *Brines, *Seawater, *Water chemistry, Mixing, Chemical precipitation, Geochemistry, Water temperature, Sampling, Oceanography, Density stratification, Bottom sediments, Mineralogy, Saline water, Sulfides.
Identifiers: *Red Sea, Hot brines.

Information is presented on the geochemistry of the hot brines in Atlantis II Deep. Special emphasis is given to the origin of manganese and iron and to the source of the sulfur species in both sediments and brines. It is concluded that the fractionation of iron and manganese is principally a pH/Eh effect and that the sulfate ions in the brine waters are derived from the overlying Red Sea waters rather than supplied directly by the discharging brines. (See also W70-07394). (Knapp-USGS)
W70-07399

GEOCHEMISTRY AND ORIGIN OF THE RED SEA BRINES,
Scripps Institution of Oceanography, La Jolla, Calif.
H. Craig.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 208-242, 1969. 35 p, 9 fig, 7 tab, 36 ref. NSF Grants G-24479 and GA-666; ONR Grant Nonr 2216 (23).

Descriptors: *Hot springs, *Brines, *Water chemistry, *Sea water, Mineralogy, Aqueous solutions, Saline water, Mixing, Geochemistry, Tracking techniques, Stable isotopes, Radioisotopes, Salts, Salinity, Sulfates, Chlorides, Chemistry, Geothermal studies, Radioactive dating, Density stratification, Density currents, Groundwater movement.
Identifiers: *Red Sea, *Hot brines.

In a steady-state model of the brine waters in Atlantis II Deep, the deuterium and oxygen-18 concentrations in the water and the dissolved argon content suggest a relative warm near surface Red Sea water as the source of the brine. In evaluating the overall environmental situation in the Red Sea in terms of temperature and salinity, the probable source lies about 800 km to the south near the Strait of Bab el Mandeb. By integrating isotope data and the trace and major element spectra of the brine, the origin, age and history of the brine waters are outlined. (See also W70-07394). (Knapp-USGS)
W70-07400

ANOMALOUS STRONTIUM IN THE RED SEA BRINES,
Ohio State Univ., Columbus. Dept. of Geology.
Gunter Faure, and Lois M. Jones.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 243-250, 1969. 8 p, 2 fig, 3 tab, 18 ref.

Descriptors: *Hot springs, *Sea water, *Brines, *Strontium radioisotopes, *Stable isotopes, Geochemistry, Mineralogy, Bottom sediments, Chemical precipitation, Provenance.
Identifiers: *Red Sea, Hot brines.

The hot brines of the Atlantis II and Discovery Deeps of the Red Sea contain strontium of very similar isotopic composition, characterized by an average Sr-87/Sr-86 ratio of 0.7080. This ratio differs significantly from that of normal Red Sea water which has a ratio of 0.7097. The concentrations of strontium in the 56 deg C brine of the Atlantis II Deep and in the 44 deg C brine of the Discovery Deep are very similar and average about 45 ppm. The Sr/Chlorinity ratios of both brines are also similar and average 0.29. The concentrations of strontium, the Sr-87/Sr-86 ratios and the chlorinities of all of the water samples from the Red Sea deeps are consistent with mixing of brine with normal sea water. The Sr-87/Sr-86 ratio of the authigenic minerals of sediment samples from the deeps changes with depth below the sea bottom; at a depth of several meters the ratio of the sediment from both deeps has a value of 0.7112. This may represent the strontium present during the Pleistocene glaciation when the Red Sea was isolated from the open oceans. (See also W70-07394). (Knapp-USGS)
W70-07401

LOW MOLECULAR WEIGHT HYDROCARBON ANALYSES OF ATLANTIS II WATERS,
Naval Research Lab., Washington, D.C. Ocean Sciences Division.
J. W. Swinnerton, and V. J. Linnenbom.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 251-253, 1969. 3 p, 1 tab, 4 ref.

Descriptors: *Brines, *Sea water, *Hot springs, *Organic compounds, Water analysis, Water chemistry, Gas chromatography, Methane.
Identifiers: *Hydrocarbons, *Red Sea, Hot brines.

Preliminary data on the low molecular weight hydrocarbon content in Atlantis II waters are presented. Relative to normal sea waters the low molecular weight paraffins are enriched in the brines by a factor of about 10 to 1,000. The enrichment is most pronounced for methane and ethane. (See also W70-07394). (Knapp-USGS)
W70-07402

ELECTROPHORETIC WATER CLARIFICATION TECHNIQUES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05D.
W70-07512

2L. Estuaries

SAND WAVES: CAPE HATTERAS, NORTH CAROLINA,
Virginia Univ., Charlottesville.
Robert Dolan.
Shore and Beach, Vol 38, No 2, p 22-25, April 1970. 4 p, 2 fig, 7 ref. NPS Contract 14-10-0131-1577.

Descriptors: *Beaches, *Sediment transport, *Littoral drift, *Sand waves, Sedimentary structures, Sand spits, Currents (Water), Sand bars, Dunes, Movement, Geomorphology.
Identifiers: Cape Hatteras (N C), Beach sand waves.

Examination of an aerial photograph of almost any reach of the mid-Atlantic coast shows that the shoreline is seldom straight, but wave-like in plain view. These sinuous forms are called sand waves and they usually occur as fields of parallel points and embayments. The projections and embayments are thought to be shoreline manifestations of complex but systematic transverse bars and troughs that

are common along most sandy coasts. This configuration suggests that the shoreline and inshore parts of the beach respond to a system of interrelated processes, and not as randomly distributed irregularities dependent wholly upon local conditions. In some areas there appears to be a distinct hierarchical arrangement of sand features, with smaller crescentic features grouped within larger ones. Sand wave lengths, defined as the distance between seaward projections, range from 500 to 3,000 ft, with most between 2,000 and 3,000 ft. Sand wave amplitudes, defined as the distance between the innermost part of the embayments and maximum point of the projections, average about 50 to 75 ft; however, large sand waves may reach amplitudes of 125 ft. The rate of migration, which appears to be a function of the energy gradient, ranges up to 600 ft per month. (Knapp-USGS)
W70-07154

TIDAL FLAT SEDIMENTATION AT COOLEY LANDING, S. W. SAN FRANCISCO BAY,
San Francisco State Coll., Calif. Dept. of Geology.
Raymond Pestrong.
Stanford University Technical Report, 1970. 55 p, 23 fig, 4 tab, 22 ref. ONR Contract Nonr-4430 (00), Project NR 388077.

Descriptors: *Tidal marshes, *Mud flats, *Sediment transport, *Deposition (Sediments), Sedimentology, Mud, Sands, Silts, Currents (Water), Waves (Water), Tidal waters, Intertidal areas, Shores, Tidal effects, Wetlands, Deltas.
Identifiers: San Francisco Bay (Calif).

Sediments transported and deposited within the low energy environment of the tidal marshes and mud flats of San Francisco Bay are primarily between 9 and 10 1/2 phi in diameter and are distributed in accordance with a principle of scour and settling lag. The finer sediments are concentrated nearer the higher portions of the tidal flats and marshes where lower ebb flow velocities are unable to transport them farther bayward. Greater quantities of bedload sediment are moved on the flood than on the ebb portions of the tidal cycle both on the tidal flat and through the marsh channel system. Flow conditions peculiar to the marsh-mud flat interface result in the bulk of sedimentation occurring on the uppermost tidal flats, at the base of the marsh. The growth of the tidal channels accompanies the extension of the marsh onto the tidal flat. An equilibrium condition is reached when deposition of sediments at the front of the marsh is matched by erosion of these deposits by the swifter tidal currents that are present as the marsh front approaches the main Bay channel. Higher shear strengths and densities are displayed by the slightly elevated tidal channel levees than by the adjacent mud flats because of the longer periods of desiccation in the levees. (Knapp-USGS)
W70-07163

PHOTOGRAPHIC MONITORING OF SHORELINE MOVEMENT,
Corps of Engineers, Wilmington, N.C.
For primary bibliographic entry see Field 07B.
W70-07164

EUTROPHICATION OF ESTUARIES,
Woods Hole Oceanographic Institution, Mass.
Bostwick H. Ketchum.
Eutrophication: Causes, Consequences, Correctives, p 197-209. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 5 fig, 7 ref.

Descriptors: *Estuaries, *Eutrophication, *Water pollution effects, Phosphate, Nitrogen, Seawater, Phytoplankton.
Identifiers: New York harbor, Secondary pollution, Hudson River estuary.

The complex characteristics of estuarine circulation provide for both upstream and downstream transport of pollutants. Treatment of domestic sewage to decrease amount of organic matter and biochemical oxygen demand by remineralization may not be effective, since essential nutrients remain in the effluent and may stimulate organic production equal to the organic matter remineralized. Phosphorus and nitrogen are the most common factors which limit marine phytoplankton production. Studies of the relationship between chlorophyll and inorganic phosphate suggest that 2.8 microgram atoms per liter of phosphate is the approximate upper limit for unpolluted water. Beyond this value, insufficient oxygen is present in deep water to oxidize resulting organic production by phytoplankton. Phosphorus values above 2.6 microgram atoms per liter in winter and 1.7 microgram atoms per liter in summer may result in anoxic conditions which will support denitrification, sulfate reduction and the production of hydrogen sulfide. Phosphate concentrations of 1.7 and 2.6 microgram atoms per liter may be considered as conservative danger limits. Controlled fertilization of estuaries is desirable in terms of increased food production; however, the relationships involving conversion of phytoplankton to higher trophic levels are poorly understood and require considerable additional research. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07271

A METHOD FOR PREDICTING POLLUTANT TRANSPORT IN TIDAL WATERS,
Calif., University, Berkeley. Hydraulic Lab.
For primary bibliographic entry see Field 05B.
W70-07366

ESTUARINE POLLUTION IN THE STATE OF HAWAII. VOL. I: STATEWIDE STUDY,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W70-07513

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING DEVELOPMENTS - A PROGRESS REPORT ON DESALINATION,
Water Research Association, Medmenham (England).
M. J. Burley.
Aqua, Issue No 1, London, England, p 23-32, 1970. 10 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Desalination, *Desalination processes, *Reviews, Surveys, Costs, Water treatment, Desalination plants, Distillation, Dialysis, Electrodialysis, Freezing, Reverse osmosis.
Identifiers: Desalination costs.

This paper discusses desalination developments since 1966 and enlarges on some aspects of the use of desalination. Today there are 90 mgd of plant in operation or under construction, and there is every indication that this extremely rapid growth rate will continue. The majority of plant continues to be installed in the Middle East or in island sites such as Malta where conventional water supplies are unavailable or very expensive. Multistage flash (MSF) distillation is the only process in commercial use for sea water desalination although a 0.83 mgd plant using the multiple-effect, long-tube vertical (LTV) process is at present being commissioned. The vacuum freezing process has now been developed to a commercial stage and small units are being marketed. For conversion of brackish water, electrodialysis is the established technique although a number of small reverse-osmosis plants are in operation. At this stage it appears that for feed waters with less than 3,000-4,000 mg/liter TDS electrodialysis is more economic, but for the treatment of higher salinity waters reverse osmosis is cheaper. The vacuum-freezing process has been demonstrated as entirely feasible, and small units are now available. By operating desalination plant in conjunction with conventional water resources according to a planned rule, the effective cost of the increased yield can, in some cases, fall well below the cost of base-load desalination. (Knapp-USGS)
W70-07357

BIOLOGICAL ASPECTS OF THE SALINE WATER PROBLEM,
Philco-Ford Corp., Philadelphia, Pa.; National Institutes of Health, Bethesda, Md.; California Univ., Davis; Harvard Medical School, Boston, Mass; and Yeshiva Univ., New York.
Ross C. Bean, R. Wayne Albers, S. Roy Caplan, Emanuel Epstein, and Robert Katzman.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $0.45. Office of Saline Water Research and Development Progress Report No 513, 1970. 33 p, 1 fig, 20 ref, 5 append.

Descriptors: *Desalination, *Membrane processes, *Biological properties, *Saline water, Desalination processes, Electrodialysis, Dialysis, Osmosis, Reverse osmosis, Ion exchange, Separation techniques.
Identifiers: Biological membranes.

Research on living organisms yielded a background of potentially useful information on desalination membranes. Nature has provided highly efficient mechanisms, in living organisms, for the performance of the exact function desired in desalination-the extraction of ions from water against tremendous chemical potential gradients. Such uphill movement is generally accomplished through the coupling of free energy available from a chemical reaction to the ion movement in the process of 'active transport'. Biological and model systems studied include membrane structure, properties of reconstituted membranes, ionophores, adenosinetriphosphatase ion pumps, organelle transport of water and ions, energetics, enzyme bonding, and effects of ions on molecular structures and interactions. A successful chemodialysis cell may offer considerable advantages over present methods of membrane desalination, and on thermodynamic grounds there is no reason to suppose that the process could not compete economically. (Knapp-USGS)
W70-07376

SECOND REPORT ON HYDRATE REACTION KINETICS AND ICE-CRYSTAL GROWTH RATES,
Syracuse Univ. Research Inst., N.Y.
J. G. Vlahakis, Tsun-chiu Tsao, H. A. Richard, A. J. Barduhn, and S. A. Stern.
Office of Saline Water Research and Development Report No 497, Dec 1969. 44 p, 5 fig, 2 tab, 10 ref. OSW Grant No 14-01-0001-1455.

Descriptors: *Desalination processes, *Hydrate processes, *Kinetics, *Freezing, Hydrates, Separation techniques, Ice, Chemical reactions, Thermodynamic behavior, Water chemistry.
Identifiers: Freon hydrates, Freezing-hydration desalination.

A theoretical model assumes that ice-crystal growth in the direction is entirely heat-transfer controlled, and that all the heat is transferred from the ice crystal to the liquid by convection. The growth rate is predicted to vary as the water flow rate to the 1/2 power and the applied subcooling to the 3/2 power. This prediction has been verified experimentally. At very low subcooled water velocities, the rate of ice-crystal growth is likely to be controlled by heat transfer by axial conduction provided that free convection effects can be neglected; however the convective heat transfer mechanism may control the ice-crystal growth rates at subcooled water velocities as low as 0.2 cm/sec. Freon-31 hydrolysis is a first-order reaction with respect

to the dissolved reactant gas, and is independent of pH. The hydrolysis of Freon-31 was also studied in the presence of metallic iron and copper, which may contaminate the aqueous solutions in a large-scale process. The hydrolysis rate at 34.5 deg C. was unaffected by iron alone or both iron and copper in the reacting solution, but when only metallic copper was present, the rate at 34.5 deg C. increased by nearly 35% after 50 hours and remained essentially constant thereafter. Studies were made on the rates of formation of Freon-31 hydrate in aqueous NaCl solutions. (Knapp-USGS)
W70-07377

OPTIMUM OPERATION OF DESALTING PLANTS AS A SUPPLEMENTAL SOURCE OF SAFE YIELD,
Utah Water Research Lab., Logan.
Calvin G. Clyde, and Wesley H. Blood.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $1.50. Office of Saline Water Research and Development Progress Report No 528, Apr 1970. 125 p, 19 fig, 15 tab, 6 ref, 3 append. OSW Contract No 14-01-0001-1711.

Descriptors: *Desalination plants, *Reservoirs, *Conjunctive use, *Systems analysis, *Computer programs, Mathematical models, Costs analysis, Optimization, Water costs, Reservoir operations, Reservoir design, Design criteria, Design data, Planning, Water supply.
Identifiers: Desalination plant design.

A digital computer program was developed for applying modern operational hydrology to determine the firm yield that will be added by conjunctive use of a desalting plant with another water supply and the associated cost of the firm yield. The principal problem concerns the plant operating rule; i. e., when to turn the plant on and off. The computer program screens the possible operating rules and eliminates those that cannot produce the required water or those that inefficiently produce too much. The remaining rules are then utilized in a cost subroutine that determines the cost of producing the added firm yield. The near optimum rule can then be selected. Using generated hydrologic sequences as an input, the central problem which the computer program must solve is the determination of correct operating rule considering other inputs of demand and cost. Once the correct operating rule is determined, the unit cost of new firm yield is known. Furthermore, a repeated series of computations, each with a different plant size, leads to a choice of a near optimum plant capacity. Similarly, the best reservoir size can be investigated. The unit cost of water from the desalting plants decreased with increasing size and plant factor. When these plants are considered as part of a conjunctive system, a completely different effect on the overall cost of water would result. Only one fuel cost and interest rate is used. Their share (fuel and fixed charges) of the cost can be readily adjusted for other values which, if not greatly different, will still yield reasonable estimates for the total cost of water from these desalting plants. Thus, this information can be used in a wide range of conjunctive water system cost studies. (Knapp-USGS)
W70-07378

DEVELOPMENT OF AN ANALYTICAL MODEL OF A FLASH STAGE - PART II,
Connecticut Univ., Storrs. School of Engineering.
Charles H. Coogan, Jr., David A. Fisher, P. S. Brewster, and H. L. Ornstein.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $1.00. Office of Saline Water Research and Development Progress Report No 503, Dec 1969. 112 p, 35 fig, 92 ref. OSW Contract No 14-01-0001-1240.

Descriptors: *Flash distillation, *Hydraulics, *Fluid mechanics, *Thermodynamics, *Mathematical models, Flow, Jets, Mixing, Turbulence, Evaporation, Turbulent flow, Orifices, Model studies, Mathematical studies.
Identifiers: *Multistage flash distillation, Fluid dynamics.

A simple analytical model was devised to be used in the design of sea water flash evaporators. It provides approximate values of the significant design variables for properly specified input variables, the most significant of which is the liquid quality. The turbulent thermal conductivity is also very significantly affected by the large changes in quality and density which may occur in the jet region. Profiles of temperature, velocity and void fraction, taken throughout the evaporator stage are of value in attempting to improve the simplified flow model. The analytical model requires that a turbulent thermal conductivity be experimentally determined. A flow equation for the simple entrance orifice is proposed which agrees reasonably well with physical data. This equation relates the flow rate per unit area at the orifice to the inlet temperature, thereby relating the flow rate to flashdown for any inlet temperature. The simplified model of a flash stage assumes constant horizontal velocity, level free surface and various entrance temperature distributions. Using a constant value of turbulent thermal conductivity throughout the stage, the evaporation ratio is related to stage length, average liquid depth, and the inverse of the turbulent Peclet Number. A relation between jet flow and turbulent thermal conductivity is postulated. (Knapp-USGS)
W70-07379

REVERSE OSMOSIS PROCESS FOR WATER REUSE APPLICATION,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-07389

DISPOSAL OF EFFLUENTS FROM DESALINATION PLANTS,
Dow Chemical Company, Freeport, Tex.; and Texas A and M Univ., College Station.
For primary bibliographic entry see Field 05E.
W70-07391

3B. Water Yield Improvement

METHOD OF COMPUTING THE DYNAMICS AND YIELD OF SNOW WATER,
For primary bibliographic entry see Field 02C.
W70-07207

EVALUATION OF THE EFFECTS OF REDUCED TRANSPIRATION UPON SOIL MOISTURE RETENTION IN AN ASPEN STAND THROUGHOUT THE GROWING SEASON IN NORTHERN UTAH,
Utah Center for Water Resources Research, Logan.
Michael Zan.
Available from the Clearinghouse as PB-192 221, $3.00 in paper copy, $0.65 in microfiche. Utah State University Center for Water Resources Research Report CWRR-14-2, Masters Thesis in Forest Science, 1968. 50 p, 6 fig, 10 tab, 44 ref. OWRR Project A-004-UTAH (3).

Descriptors: *Transpiration control, *Water yield improvement, *Evapotranspiration control, *Chemcontrol, *Utah, Evaporation control, Transpiration, Evapotranspiration, Water conservation, Vegetation effects, Consumptive use.
Identifiers: Aspen trees, Antitranspirants.

The direct effects of chemically-induced reduced transpiration on soil moisture were studied in a subwatershed of the greater Logan River drainage, Utah. No statistically significant differences occurred among the total amounts of water transpired by the treated and control units. The seasonal low points of soil moisture, in September, showed no significant differences in final moisture retention for the two years studied, either for the control or the treated portions of the study site. The 1967 season showed a lag in soil moisture depletion compared to the 1966 season. Although a later spring in 1967 may have aided in the explanation of this lag, there was good reason to believe that the antitranspirant treatment incurred a significant delay in water use. There was evidence that more effective application of chemicals might have given more positive results. (Knapp-USGS)
W70-07331

SPECTRAL INFRA-RED REFLECTION MEASUREMENTS FROM NATURAL AND TREATED ASPEN FORESTS,
Utah Center for Water Resources Research, Logan.
For primary bibliographic entry see Field 07B.
W70-07332

OPTIMUM OPERATION OF DESALTING PLANTS AS A SUPPLEMENTAL SOURCE OF SAFE YIELD,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 03A.
W70-07378

COMPUTER DETERMINATION OF CLOUD SEEDING AREA OF EFFECT,
North American Weather Consultants, Goleta, Calif.
R. E. Elliott.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 69-74, 1969. 6 p, 3 fig, 11 ref.

Descriptors: *Cloud seeding, *Mathematical models, *Runnoff forecasting, Water management (Applied), Water yield, Water yield improvement.
Identifiers: Cloud seeding models.

Mathematical models used to predict cloud seeding results are briefly reviewed. Most models have been directed toward predicting the lee wave patterns which develop most noticeably under stable air mass conditions. In orographic seeding, major concern is with the flow upwind of crests under unstable to slightly stable conditions. The analytical models provide some useful working parameters involving stability and vertical wind shear in the inflow section. Unfortunately, these parameters change as the air flows over a finite barrier. The solution is the minimum energy solution only in the case of an infinitesimal barrier. It departs most radically from the minimum energy solution in the case of neutral stability, the case of considerable interest to orographic seeding. A dispersal mechanism of controlling importance in much orographic seeding is convection. It is essential to compute a water budget for water in its various forms, vapor, liquid cloud water, cloud ice particles, and precipitation particles within the appropriate mixing mechanism. Growth is very definitely limited by the availability of water. Precipitation particles falling from convection, or from aerial seeding of stratoform cloud, continue to grow and to drift horizontally on descent, and may also be water budget-limited in their growth. A satisfactory numerical model for predicting the area of effect of cloud seeding can be developed on the basis of existing knowledge about mountain air flow, plume dispersal, cloud physics, and water budget. (See also W70-07539). (Knapp-USGS)
W70-07538

AIRBORNE SEEDING TECHNIQUES APPLIED TO WINTER OROGRAPHIC CLOUDS,
EG and G, Inc., Boulder, Colo. Environmental Services Operation.
J. Owen Rhea, and Larry G. Davis.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 75-81, 1969. 7 p, 6 fig, 1 tab, 2 ref. Bureau of Reclamation Contract No 14-06-D-5640.

Descriptors: *Cloud seeding, *On-site investigations, Evaluation, Colorado, Performance, Water yield improvement, Water management (Applied), Testing, Silver iodide, Aircraft.
Identifiers: Aerial cloud seeding application.

Airborne release of seeding material in winter orographic clouds has several advantages over ground-based seeding. These are (1) Partial elimination of necessary reliance on vertical diffusion processes to deliver seeding material to the desired temperature regime; (2) ability to target more accurately based on crystal trajectory calculations; (3) visual observations of cloud coverage from the seeding aircraft (estimates of bases, tops, and orographic characteristics; and (4) airborne monitoring of ice nucleus counts in the seeded area subsequent to seeding release. A study was made of 15 airborne seeding events at the Park Range project, Colorado. Some of the silver iodide particles released serve as ice nuclei in nucleating snow crystals which fall in the target area. Precipitation rate signatures from optical snow sensors frequently reflect the arrival of the seeding effect in the target area in agreement with calculated arrival time. The seeding effect from only a few minutes of AgI release can last for 1 to 4 hours. Pre-flight targeting calculations are sufficiently accurate to allow seeding material release to fall out over most of the primary target area in nearly all cases. (See also W70-07540). (Knapp-USGS)
W70-07539

3C. Use of Water of Impaired Quality

WASTEWATER REUSE - A SUPPLEMENTAL SUPPLY,
Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 05D.
W70-07151

3E. Conservation in Industry

THE CHARACTERISTICS AND POLLUTIONAL PROBLEMS ASSOCIATED WITH PETROCHEMICAL WASTES, SUMMARY REPORT,
Engineering-Science, Inc. Texas, Austin.
For primary bibliographic entry see Field 05D.
W70-07511

3F. Conservation in Agriculture

THE DEVELOPMENT OF A MODEL TO EVALUATE HYDROLOGIC RISK IN A WATER RESOURCE SYSTEM,
Battelle Memorial Inst., Richland, Wash.; and Texas A and M Univ., College Station.
For primary bibliographic entry see Field 04A.
W70-07246

ECONOMIC VALUES OF IRRIGATION WATER IN FOUR AREAS ALONG THE SNAKE RIVER IN IDAHO.
Idaho Agricultural Experiment Station, Moscow.
Karl Lindeborg.
Available from the Clearhouse as PB-192 117, $3.00 in paper copy, $0.65 in microfiche. Idaho Agricultural Experiment Station, Idaho University, Bulletin 513, January 1970. 27 p, 5 fig, 14 tab, 4 ref, append. OWRR Project A-017-IDA (1).

Descriptors: *Irrigation water, *Economics, *Value, *Water values, Cost-benefit analysis, Prices, Pricing, Computer programs, Linear programming, Mathematical models, Systems analysis.
Identifiers: Snake River (Idaho).

Four areas in Southern Idaho were included in a study of irrigation water value. Information collected by personal interviews included physical as well as economic data pertaining to input and output of the main crop enterprises. The economic models used in estimating the value of water were based on partial farm budgeting and linear programming. Included in the economic models were variables of farm size, farm organization, water supply, and restraints on acreage. The first linear programming model was designed for a fixed water supply for three representative farms of 320 acres each. The price of water common to the 3 areas was $27.24 for the last acre-foot of water. A second parametric programming model was designed for a variable supply of water. The restraints were the same as in the first model. The results of this model were a range of Marginal Value Products for each of the crop enterprises in each of the 3 areas. A third parametric model was used for different-sized farms in 2 areas. The results showed an increasing ability to pay for water with increasing farm size. (Knapp-USGS)
W70-07334

QUALITY ASPECTS OF FARM WATER SUPPLIES.
Victorian Irrigation Research and Advisory Services Committee, Melbourne (Australia).
For primary bibliographic entry see Field 05G.
W70-07375

BUREAU OF RECLAMATION PUMPED STORAGE PLANTS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 08C.
W70-07432

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

OPTIMAL RESERVOIR RELEASES FOR WATER QUALITY CONTROL,
Federal Water Quality Administration, Annapolis, Md. Chesapeake Technical Support Lab.; and Michigan Univ., Ann Arbor. Dept. of Sanitary and Water Resources Engineering.
For primary bibliographic entry see Field 05G.
W70-07150

FLOOD PLAIN INFORMATION, ST. CHARLES RIVER, PUEBLO, COLORADO.
Corps of Engineers, Albuquerque, N. Mex.

US Army Corps of Engineers Flood Plain Report, March 1970. 35 p, 5 fig, 24 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Colorado, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: St. Charles River (Colo), Pueblo (Colo), Standard project flood, Intermediate regional flood.

Flooding of the St. Charles River, Pueblo, Colorado is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07161

FLOOD PLAIN INFORMATION, MINGO CREEK, TULSA, OKLAHOMA.
Corps of Engineers, Tulsa, Okla.

US Army Corps of Engineers Flood Plain Report, March 1970. 32 p, 7 fig, 18 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Oklahoma, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Tulsa (Okla), Mingo Creek (Colo), Standard project flood, Intermediate regional flood.

Flooding of Mingo Creek, Tulsa, Oklahoma is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07162

THE APPLICATION OF CONCEPTUAL CATCHMENT MODELS TO RIVER FORECASTING,
Weather Bureau, Silver Spring, Md.
T. J. Nordenson.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 181-192, 1969. 12 p, 16 ref.

Descriptors: *Mathematical models, *Streamflow forecasting, *Simulation analysis, *Synthetic hydrology, *Reviews, Streamflow, Flood forecasting, Data processing, Digital computers, Computer programs, Water management (Applied), Routing, Water resources development.
Identifiers: Watershed models, River forecasting.

The application of conceptual catchment models to river forecasting is described. River forecasting is defined as the simulation of the streamflow hydrograph. The simulation of streamflow is a vital requirement in developing comprehensive water-resource plans to fulfill the needs of navigation, municipal and industrial water-supply, irrigation, hydro-electric power, flood control, watershed protection and management, and recreational activities. The models described are the Stanford Watershed Model, the Utah State Simulation Model, the Agricultural Research Service Model, the Columbia River Basin Model, the U.S. Weather Bureau model, the API model, and Soil-moisture accounting. (Knapp-USGS)
W70-07183

SHORT-TERM FLOOD FORECASTING WITH THE RETENTION MODEL,
New South Wales Univ., Kensington (Australia).
F. C. Bell.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 193-207, 1969. 15 p, 6 fig, 4 tab, 9 ref.

Descriptors: *Flood forecasting, *Runoff forecasting, *Mathematical models, *Simulation analysis, *Rainfall-runoff relationships, Model studies, Water storage, Infiltration, Overland flow, Base flow, Soil moisture, Open channel flow, Streamflow.
Identifiers: Retention model.

In the retention model for short-term flood forecasting, a catchment is regarded as an interconnected system of catchment units and channel units. The number of units desirable for larger catchments depends on storm characteristics, soil/vegetation heterogeneity and the amount of data available. Each catchment unit consists of a retention storage and a runoff storage. The retention storage is the water in the catchment that is unlikely to become streamflow, namely the 'capillary'

soil moisture, precipitation intercepted by vegetation, and some parts of the depression, groundwater and channel storages. The runoff storage consists of overland flow, 'free' water moving through soil or litter, groundwater, and storage in minor channels. Channel units are intended to simulate the effects of the major stream channels in conveying the runoff from the runoff storages to the catchment outlet. The total operation of the model requires a separate accounting procedure for each retention and runoff storage during both wetting and drying phases. This allows for the effects of area variability, especially in precipitation. The outflows from each runoff storage are appropriately combined in the channel units and the outflow from the final channel unit represents the stream flow at the catchment outlet. The retention model appears suitable for short-term flood forecasting, and may have special advantages for large and variable catchments. Although its operational elements are simpler and more flexible than those of other conceptual models, it maintains a reasonable degree of physical reality and should therefore be reliable under a wide range of conditions. (Knapp-USGS)
W70-07184

FLOOD FORECASTING AND CONTROL OF THE LEVEL OF LAKE BURLEY GRIFFIN,
Commonwealth Dept. of Works, Canberra (Australia).
B. J. Fitzgerald.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 227-241, 1969. 15 p, 10 fig, 3 ref.

Descriptors: *Flood forecasting, *Telemetry, *Routing, *Flood protection, Water levels, Reservoirs, Flood control, Reservoir operation, Reservoir design, Water management (Applied).
Identifiers: Lake Burley Griffin (Canberra-Australia).

Lake Burley Griffin is an artificial lake for ornamental and recreational purposes in the heart of Canberra, Australia. As the lake is located in the heart of Canberra and has numerous buildings and public gardens on its shores, warning of forthcoming floods, control of flood levels in the lake and of releases of flood flows from Scrivener Dam are essential for the safety of the public and for avoiding or minimizing flood damage in the vicinity. During the planning of the lake, investigations were carried out to determine the degree of control of the water-level that should be practicable during a flood, and the network of water-level telemetering stations that would be necessary both upstream and in the lake. This paper describes the network of telemetering stations; tne flood-warning time provided by these stations; the methods of determining flood flow rates; operational procedures for controlling the lake-level by release of flood flows through the Scrivener Dam flood gates; procedures for ensuring public safety and minimizing flood damage both upstream and downstream of Scrivener Dam; and the degree of control of the lake water-level that should be practicable. With this network, taking into account the relative simplicity of computing inflow and releases, it is practicable to pass floods of up to 30,000 cusecs through Lake Burley Griffin and still maintain the level in Central Basin within a few inches of normal. If a flood were to exceed 80,000 cusecs the lake walls would probably be overflowed. It should be possible to forecast at least six hours in advance if floods are likely to exceed 80,000 cusecs. (Knapp-USGS)
W70-07185

SEASONAL LOW-FLOW FORECASTING,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-07186

FLOOD-FORECASTING FROM DISCHARGE DATA IN DRAINAGE NETWORKS AND FROM PRECIPITATION,
For primary bibliographic entry see Field 02E.
W70-07188

FLOOD PLAIN INFORMATION, PENNSAUKEN CREEK AND SOUTH BRANCH, BURLINGTON AND CAMDEN COUNTIES, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

US Army Corps of Engineers Flood Plain Report, July 1969. 43 p, 7 fig, 12 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Burlington County (NJ), Camden County (NJ), Standard project flood, Intermediate regional flood.

Flooding of Pennsauken Creek and South Branch, Burlington and Camden Counties, New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07192

FLOOD PLAIN INFORMATION, LITTLE LA GRUE BAYOU, HOLT QUERTERMOUS AND PRICE BRANCHES, DEWITT, ARKANSAS.
Corps of Engineers, Memphis, Tenn.

U S Army Corps of Engineers Flood Plain Report, June 1969. 46 p, 7 fig, 12 plate, 14 tab.

Descriptors: *Floods, *Flood damage, *Arkansas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *DeWitt (Ark), Standard project flood, Intermediate regional flood.

Flooding in DeWitt, Arkansas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07194

MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, CASSVILLE, WISCONSIN.
Corps of Engineers, Rock Island, Ill.

U S Army Corps of Engineers Flood Plain Report, June 1969. 60 p, 26 fig, 7 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Wisconsin, *Mississippi River, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Cassville (Wis).

Flooding of the Mississippi River, Cassville, Wisconsin is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07197

FLOOD PLAIN INFORMATION, WABASH RIVER AND WILDCAT CREEK, VICINITY OF LAFAYETTE AND WEST LAFAYETTE, TIPPECANOE COUNTY, INDIANA.
Corps of Engineers, Louisville, Ky.

U S Army Corps of Engineers Flood Plain Report, December 1968. 45 p, 13 fig, 17 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Indiana, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Wabash River, Tippecanoe County (Ind), Standard project flood, Intermediate regional flood.

Flooding of the Wabash River, Tippecanoe County, Indiana is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07212

EVALUATION OF SOIL-APPLIED HERBICIDES FOR VEGETATION CONTROL,
Bureau of Reclamation, Denver, Colo. Office of Assistant Commissioner and Chief Engineer.
N. E. Otto.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC, 20402 - Price $0.45. Research Report No. 22, Water Resources Technical Publication, 1970. 31 p, 12 tab, 15 fig, 17 ref, append.

Descriptors: *Weed control, *Soil-sterilants, Herbicides, Weeds, Soil treatment, Vegetation, Operation and maintenance, Performance tests, Field tests, Solubility, Chemicals, Statistical analysis, Semiarid land, Plant (Botany), Alluvial deposits, Atmospheric precipitation, Research and development, Organic compounds, Soil-water-plant relationships.
Identifiers: Nonselective herbicides, Root zone, Uracil herbicides, Triazine herbicides, Substituted urea herbicides, Chlorate-borate herbicides.

Twenty-seven soil-applied herbicide formulations were evaluated for ability to provide complete vegetation control in an arid area. Observational ratings of test plots indicate that the herbicides prometone and isocil consistently produced the best over-all plant control at median and high rates of treatment over a period of 5 years. Diuron provided excellent control at the high rate only. Low-rate applications were not effective beyond 3-years' exposure. Bromacil was evaluated subsequent to the initial 5-year test and found to be equal to isocil. Granular formulations of prometone, atrazine, and bromacil were equally as effective as the wettable powder formulations. Atrazine, monuron, 3-herbicide formulations containing mixtures of chlorates, borates, and substituted ureas produced notable vegetation control for 3 to 5 years, but with variable results. A summary of over-all performance of each herbicide and rate of application is presented. The report contains an appendix summarizing the results of a survey on annual soil-sterilant use on Bureau of Reclamation projects. This study was conducted to provide information useful to project operating personnel for improving recommendations and selection of herbicides for long-term vegetation control.
W70-07231

A MOVING-BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUSdFLOW SYSTEM,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02G.
W70-07233

RECENT ADVANCES IN STORAGE AND FLOODING THEORY,
Office of Naval Research, Washington, D.C.
J. Gani.
Advances in Applied Probability, Vol 1, No 1, p 90-110, Spring 1969. 1 fig, 34 ref.

Descriptors: *Mathematical models, *Floods, *Storage, *Research and development, *Dam design, *Time, River flow.
Identifiers: Markov chains.

A variety of storage and flooding models and problems were presented along with a discussion of current directions of research in the field. Specifically, the time-dependent theory of Lloyd's infinite dam and finite dam and Moran's formulation of a discrete finite dam model were outlined. Further, a brief outline of Ali Kahn's and the author's own time-dependent extension of this approach were given. A description of the problem of estimating the distribution of largest monthly floods from limited runs of river flow data considered by Moran was outlined along with the problem of regulating the flow of two confluent rivers by a dam, considered by Anis and El-Naggar. Flow regulation models and sequential methods in storage were also discussed. (Kriss-Cornell)
W70-07236

THE DEVELOPMENT OF A MODEL TO EVALUATE HYDROLOGIC RISK IN A WATER RESOURCE SYSTEM,
Battelle Memorial Inst., Richland, Wash.; and Texas A and M Univ., College Station.
William L. Bathke, and R. J. Freund.
Water Resources Bulletin, Vol 5, No 1, p 53-61, March 1969. 3 fig, 15 ref.

Descriptors: *Risks, *Hydrologic aspects, *Simulation analysis, *Computers, *Optimization, Reservoir design, Irrigation design, Texas, Water shortage, Benefits.
Identifiers: Twin Buttes Reservoir, South Concho River.

A technique for determining optimal combinations of reservoir size and irrigation development levels, with the optimum being adjusted for the effects of a highly variable water inflo, i.e., hydrologic risk, was described. The technique determined, by computer simulation, the net benefit from a selected reservoir size and irrigation development level. The method also took into account the economic loss in revenue due to tolerable water shortages. Data from the Twin Buttes Reservoir on the South Concho River to West Central Texas was used. A preliminary study of the watershed was made to determine feasible combinations of irrigation development levels and reservoir size. A region of tolerable water shortages was computed and used as a basis for determining an experimental design of combinations whose operating characteristics were simulated from an actual 39-year record of streamflow. A three-dimensional economic loss function was derived to represent more efficiently the penalty assessment for tolerable water supply deficits due to the changes in irrigation patterns associated with project development size. A response surface of net benefit was then fitted to the resulting net benefits of the various design combinations. Standard response surface technology was used to derive the optimum combinations for a desired irrigation development level. The methodology was said to be readily adaptable to more complex situations involving irrigation needs, evaporation and seepage losses, municipal water needs, flood control benefits, and economic risk due to price fluctuations in agricultural commodities produced by the irrigated land. (Kriss-Cornell)
W70-07246

PERIODIC MARKOV PROGRAMMING,
Queen's Univ., Kingston (Ontario). Graduate School of Business.
E. R. Peterson.
Journal of Canadian Operational Research Society, Vol 7, No 1, p 39-44, March 1969. 5 ref.

Descriptors: *Markov processes, *Optimization, *Time, Streamflow, Dynamic programming, Linear programming, Hydroelectric plants, Reservoirs.
Identifiers: Policy-iteration method.

A method that converges monotonically to an optimal policy for periodic Markov chains with return was developed. This was an extension of Howard's policy-iteration method and represented an alternative method to one developed by Riis which combined policy-iteration and the method of successive approximations of dynamic programming. Computationally the most time-consuming step in the policy-iteration method was solving the set of linear equations or for the value of a policy for the states in class. A hydro-electric system, where the reservoirs were usually full at the end of the high summer runoff provided an example. The concept of 'one-step transient state' was introduced to reduce the dimensionality of the optimization problem which greatly reduced the computation required. To emphasize the computational importance of determining the one-step transient states, the computation time was reduced by a factor of approximately eight in examples based on a hydro-electric system with a conditional streamflow model. (Kriss-Cornell)
W70-07249

KEENER V SHARP (RIGHT TO INSTALL WATERGATE AND OBSTRUCT FLOW THROUGH BAYOU).

111 SW2d 118-121 (Mo 1937).

Descriptors: *Missouri, *Natural streams, *Surface waters, *Bayous, Obstruction to flow, Judicial decisions, Watercourses (Legal), Dam construction, Flow control, Channel flow, Lakes, Riparian land, Riparian rights, Remedies, Rivers, Mississippi River, Overflow, Natural flow, Proprietary power, Repulsion (Legal aspects), Streamflow, Surface runoff.
Identifiers: *Watergates.

Defendants built a watergate in a bayou which connected a lake with the Mississippi River. The installation of the watergate caused water to rise in the lake and flow onto lands of the plaintiff, who owned property along the lake. Plaintiff brought an action to have the gate removed. Defendants contended that the water in the lake and the overflow therefrom constituted surface water which defendants were entitled to ward off their land along the bayou. The court acknowledged the common enemy doctrine that permits a landowner to ward off surface water from his property onto that of adjacent owners. However, the court held the lake was not surface water even though it occasionally became dry. In holding for plaintiff, the court stated that natural streams cannot be diverted to the damage of another's property without compensation. The bayou possessed the characteristics of a natural watercourse since it had well-defined banks, a channel, and contained running water most of the year. Therefore, the court ordered the removal of the watergate. (Hubener-Florida)
W70-07281

MAGARO V METROPOLITAN EDISON CO (DISCHARGE OF COLLECTED WATER ONTO LOWER LAND).

197 A 550-552 (Penn 1938).

Descriptors: *Pennsylvania, *Artificial watercourses, *Impounded waters, *Riddance (Legal aspects), Damages, Legal aspects, Judicial decisions, Bodies of water, Watercourses (Legal), Canals, Banks, Maintenance , Repairing, Floodwater, Land tenure, Land use, Overflow, Surface waters, Drains, Soil, Crops, Natural flow, Impoundments, Surface runoff.

Defendant had acquired a strip of land above plaintiff on which there was a canal formerly maintained by the previous owner. A drain from the canal discharged water into a natural watercourse. Defendant continued to maintain the drain; however, accumulated water washed out part of the canal banks and discharged an increased quantity into the natural watercourse. As a result, the watercourse overflowed and damaged plaintiff's land. In the trial court, plaintiff alleged permanent damages due to defendant's negligence in permitting the discharge of water to overflow her land. Judgment was for plaintiff, and defendant appealed. The Superior Court of Pennsylvania affirmed. The defendant was not obliged to maintain the canal, but it had acquired land with artificial banks which gathered and collected water. Such water in its natural state would not have flowed there. Defendant could not without liability permit this increased quantity of water to be discharged in a manner injurious to plaintiff's land. Plaintiff could not object to receiving water which would naturally come on her land from higher ground, but this did not justify defendant in collecting water that would flow elsewhere and discharging it onto plaintiff's land. (Duss-Florida)
W70-07282

FLOOD PLAIN INFORMATION, DAN AND SANDY RIVERS AND SANDY CREEK, DANVILLE, VIRGINIA.
Corps of Engineers, Wilmington, N.C.

U S Army Corps of Engineers Flood Plain Report, January 1970. 52 p, 12 fig, 30 plate, 19 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Dan River (Va), Sandy River (Va), Danville (Va).

Flooding of the Dan and Sandy Rivers and Sandy Creek, Danville, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07347

FLOOD PLAIN INFORMATION, CEDAR RIVER AND TRIBUTARIES, AUSTIN, MINNESOTA.
Corps of Engineers, Rock Island, Ill.

U S Army Corps of Engineers Flood Plain Report, June 1969. 72 p, 64 fig, 15 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Minnesota, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Austin (Minn), Cedar River (Minn), Standard project flood, Intermediate regional flood.

Flooding of the Cedar River, Austin, Minnesota is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07372

FLOOD PLAIN INFORMATION, ROCK RIVER, WINNEBAGO, ILLINOIS.
Corps of Engineers, Rock Island, Ill.

US Army Corps of Engineers Flood Plain Report, Dec 1969. 80 p, 60 fig, 18 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Illinois, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Rock River (Ill), Winnebago County (Ill), Standard project flood, Intermediate regional flood.

Flooding of Rock River, Winnebago County, Illinois is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07373

SPECIAL FLOOD HAZARD INFORMATION REPORT, BARTON CREEK, AUSTIN, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Available from City of Austin, and Texas Water Development Board, Austin, Texas. US Army Corps of Engineers Special Flood Hazard Information Report, Sept 1969. 6 p, 4 plate.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Barton Creek (Tex), Austin (Tex), Standard project flood, Intermediate regional flood.

Flooding of Barton Creek, Austin, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, and profiles indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages. (Knapp-USGS)
W70-07374

SPENCER V O'BRIEN (RIGHT OF RIPARIAN OWNERS TO BUILD DIVERSION WALLS).

158 SW2d 445-447 (Tenn Ct App 1941).

Descriptors: *Tennessee, *Diversion, *Diversion structures, *Riparian rights, Legal aspects, Streams, Bodies of water, Judicial decisions, Riparian land, Land tenure, Land use, Riparian waters, Flow, Overflow, Streamflow, Streambeds, Damages, Land reclamation, Watercourses (Legal), Barriers, Relative rights, Walls, Remedies.

Plaintiff and defendant were riparian owners on opposite bank of the same stream. Plaintiff sought to reclaim land along the stream by constructing a wall in the bed of the stream, thus preventing water from overflowing her property. Defendant attempted to protect her property by constructing a similar wall on the opposite bank of the stream. Plaintiff sought to enjoin defendant from further construction of her wall and to require her to tear out the existing wall in order to permit the waters to take their natural course on that side of the stream. Defendant filed a cross bill asking the court to require plaintiff to tear down plaintiff's wall and a cabin constructed where the streamwater would naturally flow. The chancellor held that neither party had committed a wrong, that each had a right to build such a wall, that each wall prevented overflow on their respective properties, and that neither wall operated to damage the other wall or the other party's property. The bill was dismissed and the Tennessee court of appeals affirmed. Riparian owners may not divert water upon property of other riparian owners to their damage. However, no damage occurred here and the walls served only to improve each owner's property. (Duss-Florida)
W70-07382

BOARD V SCHNEIDER (RELATIVE RIGHTS OF UPPER AND LOWER OWNERS TO OBSTRUCT AND DIVERT SURFACE RUNOFF).
191 SW2d 418-420 (Ky 1946).

Descriptors: *Kentucky, *Repulsion (Legal aspects), *Riddance (Legal aspects), *Surface runoff, Surface waters, Surface drainage, Obstruction to flow, Judicial decisions, Legal aspects, Natural flow, Flow, Overflow, Structures, Dams, Easements, Drains, Land, Land tenure, Diversion, Watercourses (Legal), Embankments, Barriers, Relative rights, Civil law.
Identifiers: *Servitudes.

Plaintiff was owner of an upper estate bounding defendants' lower estate. Surface water drained off along the boundary of the two estates flowing toward defendants' property. Plaintiff had placed debris on his land which interfered with the natural channel of drainage. Defendants then placed an obstruction along the boundary which backed up surface water onto plaintiff's land. Plaintiff brought suit against defendants and also the owner of the land above the two estates seeking damages and a mandatory injunction requiring defendants to remove their obstruction. The trial court dismissed the suit as to the other defendant and after hearing the evidence denied relief against the owners of the lower estate. The Kentucky court of appeals reversed, holding that the lower estate is subject to the servitude of receiving the natural flow of surface water from the upper estate. Defendants obstructed that flow. However, the owner of upper land does not have the right to divert the channel so that excess water flows on the lower land. Plaintiff apparently did this. Defendants should be required to remove their obstruction after plaintiff shall have restored his land to its previous condition. (Duss-Florida)
W70-07421

THOMAS V CITY OF CEDAR FALLS (ABATEMENT OF FLOODING CAUSED BY HIGHWAY EMBANKMENT BARRED BY LACHES).

272 NW 79-84 (Iowa 1937).

Descriptors: *Iowa, *Water level fluctuations, *Embankments, *Remedies, Judicial decision, Overflow, Water levels, Backwater, Fluctuation, Legal aspects, Water law, Local governments, Flow, Water control, Levees, Flood control, Governements, Highways, Structures, Obstruction to flow, Barriers, Damages.
Identifiers: *Nuisance abatement.

Plaintiff owned property a short distance from an offshoot of the Cedar River. An embankment supporting a highway was constructed in 1890 interrupting the course of the bayou adjacent to plaintiff's land. The embankment caused water in the bayou to flood plaintiff's land in time of high water. Plaintiff sough abatement of the nuisance caused by the embankment and requested that an opening be constructed sufficient to allow water to pass beneath the highway. Defendants claimed that any damages to plaintiff were permanent and arose at the time of construction of the embankment, thus barring plaintiff's claim on grounds of laches. The court held that where the obstruction to the free flow of water is caused by a permanent embankment and the injuries resulting are apparent at the time of construction, then the injuries are original, although not occurring immediately. The period of the statute of limitations begins at the time of construction. Plaintiff failed for 60 years to protest construction and maintenance of the embankment and was barred by laches from seeking relief for any damages arising from the construction. (Dye-Florida)
W70-07425

FENNEMA V MENNINGA (OBSTRUCTION OF SURFACE WATER FLOW).

19 NW2d 689-692 (Iowa 1945).

Descriptors: *Iowa, *Obstruction to flow, *Repulsion (Legal aspects), *Surface waters, Streamflow, Dikes, Levees, Judicial decisions, Legal aspects, Alteration of flow, Barriers, Diversion, Relative rights, Riparian rights, Flow, Flow control, Flooding, Flood damage, Easements, Water conveyance, Surface runoff, Civil law, Prescriptive rights, Remedies.

In 1913, a dike obstructing the flow of surface water from the upper land of plaintiff's grantor was erected on the lower land of defendant's predecessors. Plaintiff acquired the upper land in 1917 whereas defendant purchased the lower land in 1938. For 22 years neither plaintiff nor his predecessor in title complained about the maintenance of the dike or the frequent flooding of the upper land. However, plaintiff eventually brought an action to restrain defendant from maintaining the dike. The Iowa Supreme Court, affirming a judgment for defendant, held that the defendant had the right to assume that the adjacent landowners had acquiesced in the establishment of the dike. Plaintiff was estopped from enjoining defendant. The court reasoned that although a servient tenant cannot dam surface water and alter the natural flow thereof, the dominant tenant may by consent, express or implied, estop himself from objecting to interference with the flow of surface water. Furthermore, the dominant owner may so abandon his rights as to create a counter easement to have the water turned back upon the dominant estate. (Powell-Florida)
W70-07444

HOOSAC TUNNEL AND W RY V NEW ENGLAND POWER CO (FLOOD DAMAGE TO RAILROAD EMBANKMENT; DAM OWNERS LIABILITY FOR OPENING OF SLUICE GATES IN TIME OF EXTRAORDINARY RAINS).
42 NE2d 832-836 (Mass 1942).

Descriptors: *Massachusetts, *Dams, *Excessive precipitation, *Flooding, Floods, Washouts, Hurricanes, Judicial decisions, Legal aspects, Damages, Floodwater, Banks, Embankments, Powerplants, Maintenance, Sluices, Sluice gates, Railroads, Rivers, Streams, Flow, Overflow, Rain, Rainfall, Bridges.
Identifiers: *Negligence.

Plaintiff railroad brought suit against defendant owner of a dam and power plant for damages done to its roadbed and tracks. Plaintiff alleged negligence on the part of defendant in keeping sluice gates open during intensive flooding, thereby causing currents to wash away portions of the plaintiff's railroad embankment. The defendant answered by alleging extraordinary conditions due to intensive rainfall caused by a hurricane. The trial court directed a verdict for defendant and the Massachusetts supreme court affirmed. The flood conditions at the time of the damages constituted an act of God, and, while the defendant still had the duty to exercise reasonable care, the burden was on the plaintiff to prove defendant's negligence. The plaintiff's evidence indicated actions which might have been negligent under normal conditions, but the defendant was faced with utterly abnormal conditions. The defendant in his actions properly considered the possible effects to owners above the dam as well as those below. (Duss-Florida)
W70-07450

CITY OF ST CLOUD V PAPPENFUS (CONDEMNATION OF LAND TO BUILD HOLDING POND).

176 NW2d 85-87 (Minn 1970).

Descriptors: *Minnesota, *Local governments, *Condemnation, *Ponds, Legislation, State governments, Legal aspects, Ponding, Public rights, Eminent domain, Judicial decisions, Jurisdiction, Project planning, Drainage systems, Drainage programs, Storm runoff, Storm drains, Cities.

To improve the municipal storm drainage system the defendant city condemned land owned by the plaintiff as a site for the construction of a holding pond. The pond was to collect and hold excess storm waters before releasing them through the city's storm sewers into a nearby river. Plaintiff contended that the city had no authority to condemn and should not be permitted to pursue drainage improvements without a plan to coordinate drainage over the total watershed area. Plaintiff also contended that the condemnation was wasteful and capricious. The court found that the taking of plaintiff's land was necessary and for a proper purpose and in accord with the controlling state statute. The court also found that the city had conferred with other agencies and governmental subdivisions, and the fact that no coordinated plan was developed could not prevent the city from taking action to solve its drainage problem. It was the proper function of the city to dispose of storm water in the most effective and economical mode available. (Hubener-Fla)
W70-07465

COMMONWEALTH V MARSHALL (DRAINAGE SYSTEM ON FARM DAMAGED BY CONSTRUCTION OF HIGHWAY).
452 SW2d 404-406 (Ky 1970).

Descriptors: *Kentucky, *Highway construction, *Drainage systems, *Tile drains, Condemnation, Eminent domain, State governments, Subsurface drainage, Drainage water, Surface waters, Culverts, Ditches, Flood damage, Administration, Legal aspects, Judicial decisions, Land tenure, Compensation, Damages, Flooding.

Defendant state condemned a portion of plaintiff's farmland as a site for the construction of a highway. Plaintiff claimed that the construction virtually destroyed a tile drainage system located on a remaining portion of the land. As a result flooding occurred on plaintiff's bottom land previously drained by the tile system. Plaintiff further alleged that the damage to their land was permanent since flooding would recur. Defendants contended that photographs showing a highway culvert clogged with debris were taken during the construction period and did not fairly indicate the maintenance which would be give to highway ditches and culverts draining plaintiff's land after completion of the ihighway. In affirming the trial court's judgment for plaintiff, the court ruled that the question of whether damage to the land by impairment of the drainage system was permanent or temporary was a question for the jury, and the photographs were admissible to aid in such a determination.9see also W69-00338) (Hubener-Florida)
W70-07493

NEW ENGLAND MICA CO V WALTHAM FACTORIES (FLOODING CAUSED BY FLASHBOARDS ABOVE THE DAM).
16 NE2d 81-85 (Mass 1938).

Descriptors: *Massachusetts, *Dams, *Floods, *Flood damage, Judicial decisions, Damages, Barriers, Backwater, Design flood, Flow control, Maximum probable flood, Overflow, Retaining walls, Flood control, Flood forecasting, Floodgates, Control structures, Overland flow, River flow, Streamflow, Water injury, Levees, Floodwater.
Identifiers: Flashboards, Negligence.

Defendant operated a dam downstream from plaintiff's factory and had acquired the right to maintain flashboards 20 inches above the dam and to flood the surrounding land to that extent. From time to time defendant increased the height of the flashboards to 36 inches, which had to be removed when high water endangered the surrounding property. On one such occasion the flashboards were removed just prior to a crest in the stream which overflowed into plaintiff's factory. Plaintiff sued for damages. The court found that defendant had not acquired a prescriptive right to maintain the flashboards above 20 inches, and that to remove them at such a late time was fruitless. It held that it was not the actual flowage but the efficient height of the dam in its ordinary operation which measured the limits of the dam's operation. Defendant was found to be negligent in its operation of the dam, and the negligence was held to be the proximate cause of plaintiff's damages. The case was remanded to consider the question of damages. (Douberley-Florida)
W70-07527

PEOPLE V WILLIS (PRIVATE DRAINAGE DITCHES AS NUISANCES).

173 Misc 442, 17 NYS2d 784-790 (Ct Spec Sess 1940).

Descriptors: *New York, *Condemnation, *Easements, *Ditches, Public health, Adjudication procedure, Boundaries (Property), Drainage, Judicial decisions, Legal aspects, Land tenure, Local governments, Proprietary power, Public rights, Relative rights, Condemnation value, Drainage systems, Mosquitoes.
Identifiers: *Nuisance.

Plaintiff city had years earlier obtained an easement to build a drainage ditch across land now held by defendant. That ditch outlived its usefulness and was filled in, but several years later another ditch was dug at right angles to the old one. The record did not disclose by whom it was constructed. Defendant was attempting to improve his property by filling in the second ditch, when he was stopped by plaintiff and ordered to reopen it. Defendant refused, and the city charged him with filling in a natural drainage system in violation of a city ordinance prohibiting private nuisances. The court held that the city had no authority to convert a private drain into a public one without first acquiring the property on which the drain was located. Moreover, the ordinance made the existence of a nuisance a factual question and a condition precedent to the establishment of guilt. To establish the nuisance, it is essential to show evidence of the injury in fact. No such evidence was indicated, and no duty rested on defendant to keep the ditch on his property unobstructed. (Clarke-Florida)
W70-07544

STROUGH V CONLEY (DIVERSION OF WATER FROM NATURAL CHANNEL).

251 App Div 487, 297 NYS 785-789 (1937).

Descriptors: *New York, *Diversion, *Channeling, *Easements, Reservoir, Alteration of flow, Routing, Water supply, Natural flow doctrine, Channel flow, Relative rights, Riparian rights, Cities, Judicial decisions, Condemnation, Legal aspects, Right-of-way, Eminent domain, Natural streams, Watercourses (Legal), Cities.

Fifty years before commencement of this action, plaintiff village had acquired the right to divert four small streams into a larger stream which flowed into the village reservoir. The village subsequently acquired a supply of water from another source and desired to discontinue its former supply from the creeks and to return those waters to their original channels. Defendants, lower riparian owners over whose property the creek water had naturally flowed objected since they had improved and cultivated the former natural channel. The court held that the village was estopped from returning the waters to their natural course of flow since a city had no right to turn drainage water on lands of another. The court also held that the village could not reconstruct drainage channels over lower lands nor could they condemn land for new channels over lands. The dissent stated that the city could exercise the easement originally given to divert the waters or could cease to divert the waters at its own will, and the lower riparian owners would have no cause of action. (Hubener-Florida)
W70-07553

MOREHEAD AND NORTH FORK RY V CRAWFORD (FLOODING CAUSED BY OBSTRUCTION OF CULVERT).
296 Ky 636, 178 SW2d 14-17 (1944).

Descriptors: *Kentucky, *Obstruction to flow, *Surface drainage, *Culverts, Surface waters, Legal aspects, Judicial decisions, Land, Land tenure, Railroads, Mining, Damages, Floods, Rain, Rainfall, Flow, Overflow, Drainage, Streams, Watercourses (Legal), Flooding, Excessive precipitation.

Plaintiff landowner brought suit against defendant railroad for damages to his residence caused by overflow from a couvert maintained by defendant. Plaintiff had contracted to permit a mining company to dump rock and dirt upon his land upstream from the culvert. At the same time defendant placed some ties on its right-of-way upstream from the culvert. These were a gift to plaintiff and placed there for his use. Heavy rainfall washed the rock, dirt and ties down to the culvert obstructing the flow through it and backing the water onto plaintiff's land. Plaintiff alleged negligence of the defendant in keeping the culvert open to handle the flow. He also alleged other acts of the defendant which increased the flow to the culvert. At trial the plaintiff received judgment, but the Kentucky court of appeals reversed on the grounds that a mere scintilla of evidence was not sufficient to submit the issues to the jury. Evidence tended to show that the culvert was adequate for ordinary flow. Plaintiff's damage occurred after heavy rainfall and, from the evidence, was not due to defendant's actions. Without more evidence defendant should have received a directed verdict. (Duss-Florida)
W70-07562

WHITE V HOWE (FLOODING OF UPPER ESTATE CAUSED BY INCREASE IN DITCH EMBANKMENT BY LOWER ESTATE).
293 Ky 108, 168 SW2d 28-30 (1942).

Descriptors: *Kentucky, *Surface runoff, *Embankments, *Repulsion (Legal aspects), Surface drainage, Surface waters, Legal aspects, Judicial decisions, Ditches, Banks, Levees, Dams, Natural flow, Elevation, Damages, Land, Land tenure, Floods, Over-flow, Construction, Maintenance, Repairing, Civil law, Riddance (Legal aspects), Remedies, Obstruction to flow.
Identifiers: *Servitudes.

Plaintiffs and defendants owned adjoining farms along the boundary of which a drainage ditch had been constructed by predecessors of the present owners to drain surface water into a public ditch. Plaintiffs' land was of higher elevation than that of defendants. Defendants undertook to repair breaks in their bank and to construct an embankment to raise its elevation. The increased elevation caused diversion of the surface water from its natural flow, backing it up and flooding plaintiffs' land. Plaintiffs objected and requested that defendants restore the former level of the bank. Defendants desisted from further construction but refused to remove the completed elevation. Plaintiffs brought suit seeking an injunction requiring defendants to restore the bank to its former level. The chancellor granted relief and defendants appealed, primarily on three grounds: (1) lack of specificity in the plaintiffs' petition as to the height of the former elevation; (2) that injunctive relief was too drastic a relief as there was no irreparable injury; and (3) plaintiffs were estopped from complaining of defendants' repair of the breaks in its bank. The Kentucky court of appeals affirmed the judgment holding that the owner of a lower estate is subject to the servitude of receiving the natural flow of water from the upper

estate. Plaintiffs objected to the embankment not defendant's repairs. Finally. plaintiffs' lack of specificity in their petition was non-prejudicial. (Duss-Florida)
W70-07563

STONE V ASHURST (DRAINAGE ACROSS ADJOINING PROPERTY).

285 Ky 687, 149 SW2d 4-6 (1941).

Descriptors: *Kentucky, *Natural flow doctrine, *Repulsion (Legal aspects), *Riddance (Legal aspects), Obstruction to flow, Adjudication procedure, Boundaries (Property), Judicial decisions, Legal aspects, Proprietary power, Relative rights, Diversion, Alteration of flow, Dams, Culverts, Drains, Surface drainage, Flooding, Highways, Ditches.

Plaintiff and defendant owned adjoining land separated by defendant's driveway. Plaintiff's land was the upper estate and in order to facilitate its drainage, which naturally flowed from plaintiff's land across defendant's plaintiff built a culvert underneath defendant's driveway with defendant's reluctant permission. A culvert under a highway adjacent to plaintiff's land drained onto plaintiff's land, and in order to facilitate the movement of the water, plaintiff dug several ditches which channeled the water through the culvert under defendant's driveway. Defendant then removed the culvert and raised his driveway, causing a large pool of water to back up onto plaintiff's land. Plaintiff sought to require the defendant to replace the culvert, and defendant cross-claimed to require plaintiff to fill the ditches. The court held that a lower estate is required to receive the natural flow of surface water from the upper estate, and the lower owner has no right to create obstructions which will cause the natural flow to stop and back up on the upper ground. At the same time, the upper owner has no right to make excavations on his land by which the flow of surface water is diverted from its natural course and channeled onto the lower estate in unnatural volume. Plaintiff was required to fill the ditches, and defendant was required to replace the culvert. (Bud Clarke-Florida)
W70-07564

COLLINS V PIGMAN (INJUNCTIVE RELIEF AGAINST RIVER DIVERSION CREATED BY LANDFILL).
292 Ky 240, 165 SW2d 955-957 (1942).

Descriptors: *Kentucky, *Landfills, *Diversion, *River flow, Obstruction to flow, Currents (Water), Legal aspects, Judicial decisions, Rivers, Banks, Flow, Channel flow, Riparian rights, Abatement, Land tenure, Construction, Structures, Erosion, Washouts, Bridges, Natural flow, Watercourses (Legal), Flooding, Remedies, Damages.

Plaintiffs owned a lot and house on the riverfront opposite defendant's land. Defendant permitted the city to take rock and stone from his property to construct a bridge nearby. He also directed his employees to construct a fill along the bank of the river. This fill caused a change in the current of the river from defendant's side to plaintiffs' side and caused damage to plaintiffs' land. Plaintiffs brought suit against defendant landowner, the city constructing the bridge, and the foreman in charge of the bridge construction, seeking to enjoin further extension of the fill and to require removal of that part completed. Plaintiffs also sought damages. The chancellor dismissed the suits as to the other defendants but granted injunctive relief as to the defendant landowner. Defendant appealed on several grounds including: (1) that plaintiffs failed to show the fill changed the current or channel of the river; and (2) that they were estopped because they had waited until completion of the fill to bring suit. The Kentucky court of appeals affirmed the chancellor's decision. Evidence supported a finding that the fill diverted the current upon plaintiffs' land. The court also held that it is the general rule that one may not stand by and permit another to construct a nusiance and then seek equitable relief from the courts. However, this does not apply where the resulting damage is not apparent before completion of the structure. Such was the case here. (Duss-Florida)
W70-07569

NORFOLK AND W RY V MCCOY (DAMAGES CAUSED BY DIVERSION AND OVERFLOW; PERMANENT OR TEMPORARY).
288 Ky 458, 156 SW2d 493-497 (1941).

Descriptors: *Kentucky, *Diversion, *Landfills, *Damages, Overflow, Floods, Erosion, Washouts, Railroads, Land tenure, Land, Rivers, River flow, Judicial decisions, Legal aspects, Tidal waters, Abatement, Watercourses (Legal), Real property, Remedies, Construction, Market value.

Plaintiffs, intestate successors to deceased owner of land, brought suit to recover for damages to the land due to flooding caused by defendant railroad's construction of a fill on its property. The construction diverted the natural flow of a river onto plaintiffs' land causing the land to wash and erode. The deceased owner had brought suit to recover damages on four previous occasions, each time receiving judgment. Each time, the Kentucky court of appeals had reversed because the verdicts were excessive. In the plaintiffs' action the court again reversed, finding that there was an erroneous instruction to the jury and, again, an excessive verdict. In all the actions to recover damages, the character of the railroad fill was described as permanent. The court held that the proper measure of damages in such cases is the difference between the fair market value of the damaged land before construction and afterwards. In the trial court's instruction it was left open to the jury to determine damages based on a temporary structure. This permitted the jury to consider separate incidents of damage caused by the fill. This was prejudicial to defendant. (Duss-Florida)
W70-07584

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (TERMS OF THE STATUTE AND THE HYDROLOGIC CYCLE),
For primary bibliographic entry see Field 06E.
W70-07586

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (PRE STATUTORY SURFACE WATER RIGHTS),
For primary bibliographic entry see Field 06E.
W70-07587

SCHULTZ V PIKESH (OBSTRUCTION OF SURFACE RUNOFF).
380 Ill 75, 43 NE2d 552-554 (1942).

Descriptors: *Illinois, *Drainage, *Surface runoff, *Repulsion (Legal aspects), Judicial decisions, Surface waters, Surface drainage, Flow, Drainage water, Legal aspects, Water law, Highways, Roads, Roadbanks, Structures, Obstruction to flow, Barriers, Diversion, Relative rights, Erosion, Walls, Remedies, Erosion control.

A road separated defendant's land from plaintiff's. Drainage from the road caused flooding on the property of defendant and plaintiff. Plaintiff's land was the lowest of the two pieces of property. Plaintiff constructed an obstruction to prevent drainage from the road onto her property. Defendant constructed a corresponding obstruction to prevent drainage onto her property. Plaintiff protested that defendant's obstruction, a low concrete wall no higher than the level of her property prior to erosion, caused water to drain onto plaintiff's property. The lower court dismissed the complaint for lack of equity, and the Supreme Court of Illinois affirmed, stating that plaintiff put herself in a poor position to ask for equity by building the original obstruction. Defendant's obstruction was no greater than plaintiff's and was of no greater height than the property prior to the erosion caused by plaintiff's obstruction. (Dye-Florida)
W70-07599

FORTIER V H P HOOD AND SONS, INC (ACTION TO ENJOIN THE CASTING OF WATERS ONTO PLAINTIFF'S LANDS).
30 NE2d 253-258 (Mass 1940).

Descriptors: *Massachusetts, *Drains, *Reasonable use, *Drainage, Streams, Drainage practices, Judicial decisions, Legal aspects, Watersheds (Basins), Canals, Ditches, Pipes, Sewers, Industrial water, Easements, Drainage water, Dairy industry, Damages, Water pollution, Prescriptive rights, Cities, Relative rights.

Plaintiff brought a bill to enjoin defendant dairy from causing water to flow upon its lands. The court-appointed master found that defendant utilized certain ditches, pipes and drains across plaintiff's lands causing water in an appreciable quantity to be thrown upon them in an artificial stream. The court found that throwing an artificial stream upon the land of another, in the absence of any easement or other right, constitutes a continuing trespass for which an injunction should lie. Defendant was not relieved of responsibility for its acts by the fact that other persons and sources contributed to the flow of the same stream into which it placed its waters. Although the defense of implied easement was rejected, the court did find that the use of the drains, pipes and ditches across plaintiff's lands since 1917 did create a prescriptive easement for defendant to place upon plaintiff's land a quantity of water equal to the amount placed there in 1917 when the easement began. (Barnett-Florida)
W70-07603

FERGUSON V VILLAGE OF HAMBURG (ACTION TO ENJOIN CITY FROM DIVERTING WATERS FROM A STREAM)
5 NE2d 801-803 (NY 1936).

Descriptors: *New York, *Cities, *Diversion, *Riparian rights, Dams, Administrative agencies, Administration, Judicial decisions, Legal aspects, Streams, Structures, Obstruction to flow, Prior appropriation, Remedies, Eminent domain, Condemnation, Lakes, Reservoirs, Sewage, Outlets, Damages, Legislation, Remedies.

Plaintiff brought suit to enjoin defendant city from taking and diverting waters from a stream which crossed plaintiff's land. Plaintiff also asked for removal of a dam erected by defendant which obstructed the natural flow of water across her land. The lower court granted the injunction and required defendant to acquire the right to appropriate the waters either by grant or condemnation proceedings. The appellate court found that plaintiff was not entitled to an absolute injunction although defendant had impaired her riparian rights. The court held that inverse condemnation was the proper method of relief. Plaintiff was entitled to the amount of the past and permanent damages resulting from the impairment of her riparian rights and also to an injunction should the defendant fail to pay the damages. This would adequately reimburse plaintiff for the impairment of her riparian rights and permit defendant to continue to furnish its inhabitants with water. (Barnett-Florida)
W70-07605

EDASON V DENISON (INCREASED FLOW OVER LOWER LAND CAUSED BY DITCH IMPROVEMENT ON UPPER LAND).
194 So 342-343 (Fla 1940).

Descriptors: *Florida, *Surface drainage, *Repulsion (Legal aspects), *Riddance (Legal aspects),

Surface runoff, Drainage systems, Drainage effects, Overflow, Surface waters, Runoff, Overland flow, Ditches, Routing, Flow control, Water conveyance, Natural flow, Artificial watercourses, Channels, Natural streams, Banks, Channel improvement, Legal aspects, Judicial decisions, Relative rights, Dams.

Plaintiff and defendants were adjoining landowners. A drainage ditch originated on land of one defendant and crossed the lands of second defendant and plaintiff. Defendants deepened and widened the ditch, thereby increasing the flow across plaintiff's land and causing damage to his truck crop. Plaintiff sought to restrain enlargement of the ditch and also to restrain defendants from entering his land and destroying dams constructed to hold water off his property. The trial court enjoined defendants from destroying the dams but dismissed the bill seeking to enjoin enlargement of the ditch on defendants' lands. The supreme court affirmed the dismissal stating that an upper riparian owner may, to prevent overflow onto upper lands, improve, deepen and widen artificial channels along a natural watercourse, even though the result is to increase the volume and speed of the stream-flow over an abutting owner's land. The lower riparian owner is charged with the burden of protecting his land from the increased volume of flow, but has no cause of action against the upper proprietor. (Hubener-Florida)
W70-07609

FULLER V STATE (FLOODING; SURFACE WATER; UNPRECEDENTED RAINFALL; DRAINAGE SYSTEMS).
46 NYS2d 762-766 (Ct Cl 1944).

Descriptors: *New York, *Flood control, *Drainage systems, *Excessive precipitation, Drainage, Judicial decisions, Legal aspects, Natural flow doctrine, Proprietary power, Public rights, State governments, Floods, Overflow, Rainfall, Storm drains, Surface waters, Surface runoff, Rainfall intensity, Flooding, Surface waters.

Plaintiff's house and his personal belongings which were stored in his basement were damaged when an extradinary flood of surface water washed out a wall of the dwelling. With the construction of a housing subdivision the area surrounding plaintiff's house had changed from basically rural to residential. This construction added many new streets which intersected with the one on which plaintiff's house was located. Plaintiff contended that in view of the increased surface runoff caused by the intersection of the new streets, defendant state had been negligent in failing to provide ditches and culverts adequate to properly drain during heavy rains the street on which he lived. Moreover, it was contended, the lack of adequate drainage caused the flooding damage to his house. The court found from the evidence that the rainfall which caused the flooding was unprecedented, and that defendant had reconstructed the drainage facilities according to accepted standards applicable to the terrain. Defendant's failure to anticipate the extraordinary rainfall was not actionable negligence. In any case, damage caused by surface waters augmented by unprecedented rainfall will give no recovery. (Clarke-Florida)
W70-07613

PFEIL V TRISCHETT (IMPROVEMENTS TO LAND AND STREAMBED CHALLENGED BY LOWER RIPARIAN OWNER).
137 NYS2d 668-669 (1954).

Descriptors: *New York, *Riparian rights, *Relative rights, *Grading, Obstruction to flow, Developed waters, Watercourses (Legal), Natural flow, Levees, Natural flow doctrine, Judicial decisions, Natural watercourses, Ditches, Streams, Surface runoff, Land use, Proprietary power, Channels, Diversion, Riddance (Legal aspects), Repulsion (Legal aspects).

Plaintiff and defendants were adjoining riparian landowners, plaintiff holding land located downstream from defendants. Plaintiff brought a complaint alleging that the defendants had artificially channelled and changed the course of the stream with the result that water from defendants' property had been cast upon the land of the plaintiff. The court noted that the plaintiff did not allege that the defendants caused the stream to overflow its banks or divert the stream from the point where it originally entered plaintiff's property. The complaint did allege, however, that the defendants had increased the elevation of their land and thus increased the flow of water onto plaintiff's land. The court held the complaint insufficient, stating that the owner of lands drained by a watercourse exercises a legal right in using his land to change or control the flow of surface water therein in a reasonable manner. The reasonable grading of one's lands in making improvements thereon creates no liability for water cast upon another's land. (Hubener-Florida)
W70-07616

DRAINAGE--SANITARY DISTRICTS (STRUCTURE, FORMATION AND ADMINISTRATION).
111 Ann Stat ch 42, secs 247, 259, 260, 261, 266, 267, 270, 283, 284, 289, 291, 292, 294, 295, 296 (Smith-Hurd 1956), as amended, (Supp 1969); secs 296.1, 296.4 (1969).

Descriptors: *Illinois, *Waste disposal, *Drainage districts, *Administrative agencies, Administration, Water supply, Wastes, Legislation, Flood control, Channel improvement, Water management (Applied), Water policy, Levees, Drainage, Water pollution control, Drainage systems, Condemnation, Easements, Cost repayment, Right-of-way, Eminent domain, Legal aspects, Sewage districts, Financing, Taxes.

Areas of 2 counties or more, situated so as to be subject to overflow from any river, may be incorporated as sanitary districts with the purpose of constructing and operating facilities to improve drainage and facilitate waste disposal. Such districts shall have boards of trustees empowered to levy taxes to build levees and works, and may exercise the powers of eminent domain to obtain property necessary for performance of district functions. Limitations are placed upon the taking or use of rights on railroad, highway, street, wharf, levee or similar property. The boards of trustees may compel railroad companies to elevate their tracks. Borrowing of money, extension of facilities outside each district, condemnation and letting of contracts are regulated by statute. Acquisition of rights-of-way over public property and contracts with outside territory for use of district channels and drains are within the purview of the trustees. Sanitary districts shall have police power to regulate pollution in water supplies. Costs shall be defrayed by general and special taxation applied to property within each district and by issuance of bonds. (See also W70-07619 thru W70-07622). (Dye-Florida)
W70-07618

DRAINAGE-SANITARY DISTRICTS (FORMATION; POWERS OF TRUSTEES).
111 Ann Stat ch 42, secs 247, 159, 260 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Sewage districts, *Waste disposal, *Drainage districts, Administration, Water supply, Environmental sanitation, Wastes, Waste water disposal, Local governments, Legislation, Flood control, Channel improvement, Drainage systems, Levees, Water management (Applied), Water policy, Water law, Governments, Drainage, Legal aspects, Administrative agencies.

When any contiguous territory (1) within the limits of 2 counties; (2) containing 2 or more incorporated cities, and (3) with a population greater than 3500, is subject to overflow from any river, and the maintenance of levees or implementation of improved drainage would promote the public health or safety, the area may be incorporated as a sanitary district in the manner set forth by statute. No territory may be included in more than one sanitary district. The trustees of the district may construct and maintain such levees, drains, treatment plants, pumping plants, and outlets as may be necessary for protection from overflow and disposal of wastes. The trustees may extend such works into cities within the district for connection with municipal waste disposal facilities. The district may contract for reasonable compensation with a city for disposal of the city's wastes through district facilities. District facilities may extend beyond the limits of the district, but no taxes may be levied by the district on extra-district property. The district is liable for damage caused by its activities outside the district. (See also W70-07618). (Dye-Florida)
W70-07619

DRAINAGE--SANITARY DISTRICTS (ACQUISITION OF PROPERTY AND DRAINAGE DISTRICTS).
111 Ann Stat ch 42, secs 261, 266, 267, 270 (Smith-Hurd 1956).

Descriptors: *Illinois, *Drainage districts, *Sewage districts, *Administrative agencies, Administration, Water supply, Waste disposal, Environmental sanitation, Wastes, Waste water disposal, Local governments, Governments, Legislation, Flood control, Drainage systems, Levees, Water management (Applied), Water policy, Drainage, Condemnation, Easements, Cost repayment, Right-of-way, Eminent domain, Legal aspects.

Sanitary districts may acquire by purchase, condemnation, or otherwise property required for their corporate purpose. All moneys for such acquisition must be paid before possession is taken. When it is necessary for a district to acquire or use any portion of a railroad right-of-way, street, highway, wharf, levee, or other property of public interest, only such easement of rights necessary for the purposes of the district shall be taken. So far as praticable the use of such property shall be reserved to the public, company, or other persons entitled thereto. When necessary, the district may require any railroad company to elevate its tracks to conform to the grade of any district facility. The district may require railroads to maintain culverts, ditches, drains, or sewers for elimination of standing water on railroad rights-of-way. If any sanitary district includes within its limits any drainage district conducive to sanitary purposes, the sanitary district may appropriate such facilities on payment of the reasonable cost or value of such facilities--in no case fixed at an amount less than any unpaid indebtedness incurred by the drainage district in contracting the facilities. (See also W70-07618). (Dye-Florida)
W70-07620

DRAINAGE - SANITARY DISTRICTS (WASTE DISPOSAL; ACQUISITION AND USE OF PUBLIC PROPERTIES; CONDEMNATION; SEWAGE TREATMENT).
For primary bibliographic entry see Field 05G.
W70-07621

DRAINAGE-SANITARY DISTRICTS (COOPERATION OF DISTRICTS; POLICE POWER; COSTS).
111 Ann Stat, ch 42, secs 294, 295, 296 (Smith-Hurd 1956), as amended, (Supp 1969); secs 296.1, 296.4 (1969).

Descriptors: *Illinois, *Drainage districts, *Cost allocation, *Water supply, Administration, Sewage districts, Local governments, Governments, Legislation, Waste disposal, Water management (Applied), Water policy, Drainage, Water pollution, Water pollution control, Environmental sanitation, Administrative agencies, Coordination, Construction costs, maintenance costs, Facilities, Cities, Legal aspects, Taxes, Assessments.

Any sanitary district may allow water from other territories, on terms mutually agreed upon, to drain into district drains. Sanitary districts may organize water districts so as to provide, through use of water supplies of towns possessing such means, pure water for towns possessing no means of procuring water. A district may exercise police power to prevent pollution of water supplies of cities within the district. When operating within any city district, police officers shall act subject to the direction of minicipal authorities. Sanitary districts may defray the cost of construction, maintenance, and operation of district facilities by general taxation or special assessments. No property may be assessed for more that it is benefited by the improvement for which the assessment is levied. (See also W70-07618). (Dye-Florida)
W70-07622

LEADER V MATTHEWS (ACTION TO COMPEL REMOVAL OF DAM TO PREVENT INJURIOUS IMPOUNDMENT OF WATERS).
95 SW2d 1138-1141 (Ark 1936).

Descriptors: *Arkansas, *Watercourses (Legal), *Surface waters, *Repulsion (Legal aspects), Competing uses, Judicial decisions, Ephemeral streams, Dams, Reservoirs, Reasonable use, Impoundments, Backwater, Discharge (Water), Flood routing, Impounded waters, Runoff, Riddance (Legal aspects), Legal aspects, Structures, Relative rights, Land tenure, Surface runoff, Boundaries (Property).

Plaintiff sought a mandatory injunction requiring defendants to remove a dam erected along the dividing line between their properties. It was alleged that the dam obstructed a watercourse, thereby impounding waters and causing them to overflow plaintiff's land. The questions involved were whether the waters were to be considered a watercourse, and if not, could defendant properly fend the waters from his property for his own protection. Evidence adduced at trial showed that the water travelled, not in a defined watercourse, but more toward a depression or reservoir on defendant's land. The court held that floodwaters flowing into low places and filling them to overflowing do not necessarily constitute watercourses. The defendant landowner was justified in defending against such flood waters and could do so without incurring liability, unless he unnecessarily injured or damaged another. The waters in this case were overflow waters and against these the landowner had the right to defend himself, as against a common enemy, without rendering himself liable for damages. (Barnett-Florida)
W70-07629

MCCORD V BIG BROTHERS MOVEMENT, INC (DIVERSION FOR GUESTS' RECREATION).
185 A 480-482 (NJ 1936).

Descriptors: *New Jersey, *Recreation facilities, *Reasonable use, *Withdrawal, Judicial decisions, Riparian rights, Mills, Engineering structures, Mill dams, Ponds, Standing waters, Fresh water, Water holes, Streamflow, Low flow, Natural flow, Alteration of flow, Diversion, Downstream, Routing, Swimming, Stagnant water, Domestic water, Riparian owner, Legal aspects.

Plaintiffs utilized water from a stream running through their land to operate a grist mill. Water was diverted from the stream by a number of dams and returned to the stream below the grist mill. Upstream from plaintiff's mill defendant pumped water from the stream into a swimming pond to prevent it from becoming stagnant during the summer months. Plaintiffs sought restraint against further use of the pump and complained that these extractions by defendant materially increased the difficulty of mill operation during the dry summer months. The court held that a riparian owner is entitled to the reasonable use of stream waters for domestic and irrigation purposes, and that a lower owner is entitled to the natural flow undiminished by unreasonable use. Riparian rights may be claimed by the owner only, and a diversion for the use of invitees of the owner was held to exceed the reasonable use to which defendant was entitled. Since the withdrawals reduced the power of the mill by one-sixth horsepower, the court found the loss to plaintiffs to be material and the restraint justified. (Douberly-Florida)
W70-07630

KASUBA V GRAVES (LIABILITY FOR DAMAGE CAUSED BY PUMPING WATER INTO STREAM).
194 A 455-462 (Vt 1937).

Descriptors: *Vermont, *Reasonable use, *Flow augmentation, *Overflow, Judicial decisions, Riparian rights, Riparian land, Natural flow doctrine, Alteration of flow, Relative rights, Remedies, Usufructuary right, Water level fluctuations, Water levels, Overland flow, Streamflow, Discharge (Water), Flooding, Sediment transport, Culverts, Quarries, Damages, Relative rights, Legal aspects.

To drain several pits defendant quarry operator pumped water into a brook which ran throught plaintiff's farm. This pumping caused the water level to rise above a culvert placed by plaintiff between his house and barn, to overflow onto plaintiff's farm land and damage the crops, and to cut new channels through plaintiff's fields. Plaintiff sought injunctive relief and damages, but no evidence of damages was brought forward. The court held that defendant had a right to reasonable use of the stream so long as it did not cause substantial harm to plaintiff. Considering the size and character of the brook, the court found defendant's use to be unreasonable. The trial court had allowed defendant to pump as much water into the brook as was necessary for the operation of the quarry, but the appellate court held that the necessities of defendant could not measure the rights of plaintiff. Plaintiff was under no obligation to keep the culvert open to accommodate the increased volume of water. Defendant was found to have no right to discharge water so as to injure plaintiff in this manner. (Douberley-Florida)
W70-07633

ZAMELLI V TROST (LIABILITY FOR DAMAGE CAUSED BY DRAINAGE DITCH OVERFLOW).
132 NJL 388, 40 A2d 783-784 (NJ 1945).

Descriptors: *New Jersey, *Ditches, *Surface runoff, *Overflow, Judicial decisions, Dams, Canals, Drainage, Gullies, Open channels, Trenches, Water conveyance, Surface waters, Excess water (Soils), Repulsion (Legal aspects), Riddance (Legal aspects), Real property, Flow, Natural flow, Retention, Diversion, Overland flow, Runoff, Legal aspects.
Identifiers: Water damage.

Defendant's land was slightly elevated above and adjacent to plaintiff's land. Defendant dug a ditch on his own land and dammed up one end, causing the water which accumulated in it to flow onto plaintiff's property. Plaintiff sued for damages caused by the water. The court found for defendant, holding that no right can be claimed for the mere flow of surface water, and that neither its retention, diversion, repulsion or altered transmission is an actionable injury. (Douberley-Florida)
W70-07635

NOE V BENGEY (BUILDING OF WALL ALONG BANK IN RIVERBEND HALTED BY RIPARIAN OWNER ON OPPOSITE SIDE OF RIVER).

125 SW2d 721-722 (Ky 1939).

Descriptors: *Kentucky, *Structures, *Bank protection, *Walls, Riparian rights, Diversion structures, Currents (Water), Streamflow, Bank erosion, Avulsion, Bank stability, Channel erosion, Bank stabilization, Channel morphology, Embankments, River beds, Judicial decisions, Water law.
Identifiers: Accretion (Legal aspects), Legal aspects, Remedies, Flow augmentation.

Plaintiff and defendant were riparian owners on opposite sides of a river bend. Defendant began construction of a wall to extend approximately 600 feet along the river bank at the bend. Plaintiff sought an injunction to halt construction alleging that the wall would narrow the channel and divert the flow of the current so as to wash out the river bank on his side. Defendant contended that the structure was intended to prevent his own banks from washing out and that the wall would not change the course of the streamflow. The court granted the plaintiff an injunction stating that such a narrowing of the stream as would occur would throw currents against the opposite bank with much greater than normal force causing irreparable damage to the land on plaintiff's side. (Hubener-Florida)
W70-07637

HALSTEAD V YOUNG (RIGHT TO OVERFLOW LAND ADJACENT TO DAM).

276 NW 703-706 (Mich. 1937).

Descriptors: *Michigan, *Flooding, *Milldams, *Overflow, Judicial decisions, Real property, Dams, Water law, Legal aspects, Land, Land use, Submergence, Mills, Land tenure, Structures, Facilities, Streamflow, Flow, Prescriptive rights, Easements.

To the extent afforded by maintenance of an 8-foot head of water at a dam on defendant's property, defendant's ancestor in title acquired from plaintiff's ancestors in title the right to flow plaintiff's land. Defendants lowered the level of the tailrace one foot, thus increasing the head to 9 feet, but flowing no additional property. The court held that the area to be flowed is to be determined according to conditions at the time of the grant, and the lowering of the tailrace did not require lowering of the head since no additional property was flooded. The lands of one plaintiff were not included in the original grant and defendant's right to flow them depended upon acquisition of such rights by prescription. The prescriptive period for establishment of a right of flowage was 15 years, and the weight of conflicting testimony was sufficient to warrant a finding that defendants have established a prescriptive right to flow the land. (Dye-Florida)
W70-07639

MCFAUL V EAU CLAIRE COUNTY (LEASE; EASEMENT TO FLOOD; ADVERSE POSSESSION).
292 NW 6-9 (Wis 1940).

Descriptors: *Wisconsin, *Flooding, *Prescriptive rights, *Leases, Judicial decisions, Overflow, Land tenure, Real property, Dams, Water law, Legal aspects, Legislation, Land, Land use, Submergence, Easements, Local governments, Taxes, Rent, Relative rights, Public lands.

Plaintiff's grantor conveyed property to defendant county, taking back a 99-year lease and reserving in defendant the right to flood the property at any time. Rental payments consisted of payment of taxes on the property. Grantor then conveyed to plaintiff by warranty deed, plaintiff having no knowledge of the previous conveyance until four years after purchasing the property. Plaintiff never notified defendant of any intention to claim any rights in opposition to the lease. Defendant proposed to overflow the property. Plaintiff claimed title to the property by adverse possession. The court held that, since the lease was recorded, plaintiff had constructive notice of the lease and defendant's rights thereunder. Plaintiff had actual notice within four years of purchase. Plaintiff's possession was consistent with the lease and gave defendant no notice of hostile possession. There was no default in rental payments to give notice to de-

fendant. There was no adverse possession effective to establish title and defendant's right to flood the property was unchanged. (Dye-Florida)
W70-07640

THOMSON V PUBLIC SERVICE COMM'N ('-FLOOD WATERS' HELD NOT TO INCLUDE POND OVERFLOW).
5 NW2d 769-772 (Wis 1942).

Descriptors: *Wisconsin, *Surface waters, *Obstruction to flow, *Floodwater, Barriers, Ponds, Drainage, Marshes, Standing waters, Flooding, Embankments, Roadbanks, Highways, Legislation, Legal aspects, Judicial decisions, Flow, Natural flow, Railroads, Culverts, Structures, Drains, Roads, Surface drainage.

Plaintiff railroad maintained tracks upon an embankment adjacent to a surface water pond. The pond had no inlet or outlet and was filled by water draining from surrounding terrain. In times of high water the pond extended to plaintiff's embankment. Defendant Public Service Commission claimed that plaintiff's embankment obstructed the depression over which surface water would naturally flow and caused flooding to occur on adjacent property. The Public Service Commission ordered plaintiff to construct culverts to allow surface water to drain beneath plaintiff's tracks and the plaintiff sought to set aside the order. The statute under which the Public Service Commission sought to obtain construction of culverts required railroad companies to maintain culverts to protect adjacent property from damage caused by flood waters. The court held that flood waters are those which break away from the normal course of a stream under unusual conditions. The waters involved in the instant case were not flood water, but surface waters not forming part of a watercourse. The statute was inapplicable and the order of the Commission set aside. (Dye-Florida)
W70-07642

TURLEY V ARNOLD (DRAINAGE DISTRICT BENEFITS).
51 NE2d 176-183 (Ill 1943).

Descriptors: *Illinois, *Drainage districts, *Benefits, *Assessments, Drainage effects, Drainage programs, Judicial decisions, Legal aspects, Drainage systems, Water policy, Levees, Drains, Ditches, Cost allocation, Benefit sharing, Projects, Project benefits, Water rights, Adjudication procedure, Relative rights, Repulsion (Legal aspects), Riddance (Legal aspects).

Plaintiffs, commissioners of a drainage and levee district, filed a petition for an additional assessment for proposed improvements. Defendants, thirteen property owners, objected to the petition on the grounds that the purpose of the improvements was to give complete drainage to a relatively small area of the district rather than to benefit the entire district. After conclusion of their evidence, defendants requested that the jury view the area of the proposed improvements. The request was granted and the jury was taken over the lands of the district. The trial court's decision confirming the jury's assessment of benefits was reversed by the Illinois Supreme Court. The supreme court held that the trial judge was without authority to permit a jury view of the premises absent a written request before commencement of the trial. The high court also stated that when upper and lower landowners unite in forming a drainage district, the common law principle that the upper landowner is not obligated to assist the lower landowner in removing water is inapplicable. (Powell-Florida)
W70-07644

4B. Groundwater Management

DIRECTIONAL HYDRAULIC BEHAVIOR OF A FRACTURED-SHALE AQUIFER IN NEW JERSEY.,
Geological Survey, Trenton, N.J.
For primary bibliographic entry see Field 02F.
W70-07213

NASHVILLE, C AND ST L RY V RICKERT (REASONABLE USE OF SUBTERRANEAN PERCOLATIONS).

89 SW2d 889-898 (Tenn Ct App 1935).

Descriptors: *Tennessee, *Underground streams, *Reasonable use, *Percolating water, Diversion, Underflow, Legal aspects, Judicial decisions, Watercourses (Legal), Springs, Percolation, Streams, Railroads, Wells, Pumps, Water supply, Land tenure, Relative rights, Pipes, Sinks, Reservoirs, Caves, Cisterns, Groundwater.

Plaintiff railroad company, to supply its water needs, purchased from defendant an acre of land containing a spring. Thereafter, on defendant's remaining land a sinkhole was created which filled with water. Defendant drilled a well thereat and pumped out available water. When this was done, the plaintiff's spring went dry and plaintiff brought suit seeking an injunction to prohibit defendant from pumping so much water as to diminish the flow to plaintiff's spring. The chancellor issued an injunction which allowed defendant to pump water only to the extent that it would not interfere with plaintiff's water supply for his needs. The Tennessee court of appeals affirmed, holding that Tennessee follows the American rule or 'reasonable use' doctrine regarding subterranean percolations. The rights of landowners are correlative and each must use his land so as not to injure the other. Where there is a common source of supply, each owner is limited to reasonable and beneficial use. The facts indicated plaintiff purchased the land for its water supply and that such supply was diminished by defendant's pumping. (Duss-Florida)
W70-07285

OPTIMIZATION OF WELLS AND RECHARGE FACILITIES IN CONJUNCTIVE USE OF GROUNDWATER RESERVOIRS,
California Univ., Davis Dept. of Water Science and Engineering.
Verne H. Scott.
Available from the Clearinghouse as PB-192 092, $3.00 in paper copy, $0.65 in microfiche. California University Water Resources Center Project Completion Report, October 1969. 21 p, 9 fig, 9 ref. OWRR Project No B-006-CALIF.

Descriptors: *Artificial recharge, *Injection wells, *Conjunctive use, *Water management (Applied), Drainage, Dynamic programming, Systems analysis, Water utilization, Surface-groundwater relationships, Bibliographies, Groundwater movement, Drawdown, Discharge (Water).
Identifiers: Well interference.

This investigation of wells and recharge facilities was conducted through a series of related studies dealing with well interference, unsteady recharge flow through injection wells, recharge efficiency of wells and trenches, drainage by wells and the application of dynamic programming. Results of the evaluation, analysis and criteria developed are presented in 5 listed published paper with recommendations of approaches to optimal multisource-multipurpose water allocation in conjunctively managed surface-groundwater-recharge systems. (Knapp-USGS)
W70-07325

CONJUNCTIVE USE SYSTEMS ANALYSIS,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-07328

LARGEST FLOWING WELL IN CANADA AT FORT ST. JAMES,
Robinson, Roberts and Brown Ltd, Vancouver (British Columbia).
W. L. Brown.
Johnson Drillers Journal, p 1-3, March-April 1970. 3 p, 4 fig.

Descriptors: *Water wells, *Artesian wells, Water supply, Aquifers, Alluvium, Glacial drift, Water yield, Water quality.
Identifiers: Fort St. James (B C, Canada).

Fort St. James in British Columbia, Canada, provides its citizens with water from an unusual flowing artesian well. With a free flow of 4,200 gpm, or 6 million gal per day, this is the largest flowing well in Canada and perhaps the largest in North America. The well was completed in November, 1969. The shut-in pressure is 52 psi, equivalent to a head of 120 ft. This permits the town to deliver water into its water system without pumping. The well taps a sand and gravel aquifer about 30 ft thick found in a buried river channel cut into bedrock under Fort St James. Bedrock outcrops at or near the ground surface on both sides of the buried channel, roughly east and west of town. The static water level is 120 ft above ground or 2,420 geodetic. This is 190 ft higher than the water level in Stuart Lake and is higher than all of the major lake and river systems in the area. The water is hard but potable and has a temperature of 48 deg F. (Knapp-USGS)
W70-07361

WATER SITUATION IN MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
For primary bibliographic entry see Field 02F.
W70-07405

WELL SCREENS AND GRAVEL PACKS,
Water Research Association, Medmenham (England).
For primary bibliographic entry see Field 08A.
W70-07437

SOME LEGAL AND ECONOMIC IMPLICATIONS OF SEA-WATER INTRUSION - A CASE STUDY OF GROUNDWATER MANAGEMENT,
Economic Research Service, Washington, D.C. Farm Production Economics Div.
Charles V. Moore, and J. Herbert Snyder.
Natural Resources Journal, Vol 9, p 401-419, 1970. 2 fig, 1 tab, 26 ref.

Descriptors: *Groundwater, *Management, Water law, Economic feasibility, *Encroachment.

Some of the physical characteristics of saltwater intrusion into groundwater basin are described. The legal and economic problems that are encountered in applying various alternatives to the intrusion problem are defined and evaluated. Six such alternatives are considered feasible. The threat of court action by the injured parties due to intrusion causes a change away from the present status quo to one where the pumpers in the contaminated area would be as well off if they contributed to the cost of a fresh water canal rather than suffer the consequences of having the courts adjudicate the basin. This solution leads to maximization of the aggregate profit level of the entire pressure area. (Grossman-Rutgers)
W70-07524

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCE BY DYNAMIC PROGRAMMING,
California Univ., Davis. Dept. of Water Science and Engineering.
Gert Aron.

Univ Calif Water Resources Center, Contrib No 129, June 1969. 157 p, 25 fig, 11 tab, 41 ref. OWRR Project B-006-CAL.

Descriptors: *Optimization, *Dynamic programming, *Conjunctive use, *Surface-groundwater relationships, Water resources, Mathematical models, Water conservation, Pumping, Import, Distribution systems, Computer programs.
Identifiers: Santa Clara Valley.

A mathematical model was developed for a water resource. Linear and dynamic programming techniques were applied to the optimization of the model. The prime objective of the study was (a) to develop a model of a regional water conservation and distribution system under conjunctive use of surface and groundwater and (b) to develop a set of procedures for establishing water allocation and import policies of maximum economic efficiency. As a secondary objective, the study was aimed at the establishment of guidelines for the simplification and segmentation of a water allocation problem followed by a preoptimization of several subsystems, to maximize the number of state and decision variables included in the optimal policy. The Northern portion of the Santa Clara Valley was chosen as a physical model. The proposed procedures of simplification, segmentation and optimization were then applied to the Santa Clara system of water conservation, pumping, import and distribution. The system was represented by three state and twelve decision variables and optimal eight-year policy was developed in intervals of three months. Results of the computer program were discussed and suggestions for further research and improvements were made. (See also W70-07556 and W70-07557) (Thiuri-Cornell)
W70-07555

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCES BY DYNAMIC PROGRAMMING: CHAPTER III-GENERAL APPROACH TO DEVELOPING A PLAN FOR CONJUNCTIVE WATER USE,
California Univ., Davis. Dept. of Water Science and Engineering.
Gert Aron.
In: Univ Calif Water Resources Center, Contrib No 129, p 44-85, June 1969. 41 p, 8 fig. OWRR Project A-006-CAL.

Descriptors: *Optimization, *Dynamic programming, *Conjunctive use, *Surface-groundwater relationships, *Water resources, Water allocation (Policy), Systems analysis, Mathematical models, Long-term planning, California, Decision making.
Identifiers: Residual water value.

The complexity of a typical water resource system under conjunctive use of surface and groundwater was demonstrated. To optimize the allocation of water from several alternative sources to various demand centers, certain simplifictions of a prototype system were proposed in the construction of a conceptual model. The conceptual model system was then subjected to segmentation into subsystems, whose scales of development and/or operations could be optimized independently. The convergence of a dynamic programming decision sequence to a long-term optimal policy was investigated, using a simple hypothetical water allocation model. The concept of 'residual water value' introduced in the Chapter, was tested on the model and found to accelerate the convergence considerable. To test the approaches and procedures proposed in this Chapter, a prototype system, typical of agricultural-urban conjunctive use systems in California, was selected and an optimal water allocation policy for this system was developed. (See also W70-07555) (Thiuri-Cornell)
W70-07556

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCES BY DYNAMIC PROGRAMMING: CHAPTER IV-APPLICATION OF OPTIMIZATION TECHNIQUES TO A PHYSICAL MODEL,
California Univ., Davis. Dept. of Water Science and Engineering.
Gert Aron.
Univ Calif Water Resources Center, Contrib No 129, p 86-145, June 1969. 60 p, 10 fig, 9 tab. OWRR Project A-006-CAL.

Descriptors: *Optimization, *Dynamic programming, *Conjunctive use, *Surface-groundwater relationships, *Water resources, Resource allocation, Constraints, Synthetic hydrology, Computer programs, Water demand.

Dynamic programming as well as several subsidiary analytical techniques were applied to the optimization of a prototype physical model system in which conjunctive ground and surface water management was the prime consideration. Five constraints of the problem were considered. These were represented by fixed demands, limitation on water import, recharge and pipe line capacities, cost functions and physical parameters. The size of the problem was reduced to 3 state variables and 12 decision variables. The Santa Clara Valley system was chosen for an example and a computer program written for the optimization of the system's operation. Optimal allocation schedules under constraint alternatives 1 to 5 were developed for the synthetic sequence of stream flows used. Summaries of the most important consequences of the allocation schedule were presented. The optimization program resulted in an operating schedule which reflected the effects of parametric and cost relationships in a physically logical manner. (See also W70-07555) (Thiuri-Cornell)
W70-07557

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (ADVANTAGES OF THE STATUTE OVER COURT ADMINISTERED RIPARIAN RIGHTS LAW),
For primary bibliographic entry see Field 06E.
W70-07588

PLAINFIELD-UNION WATER CO V BOROUGH OF MOUNTAINSIDE (APPEAL TO SET ASIDE ADMINISTRATIVE APPROVAL OF A PROPOSED PLAN TO INCREASE WATER SUPPLY).
14 NJ 296, 102 A2d 1-7 (1954).

Descriptors: *New Jersey, *Water supply, *Administrative agencies, *Jurisdiction, Legal aspects, State governments, Natural resources, Water shortage, Water policy, Water requirements, Water delivery, Subsurface waters, Well regulations, Water wells, Permits, Regulation, Administration, Water demand, Planning, Projects, Water allocation (Policy), Local governments.

The plaintiff water companies submitted plans to the Water Policy and Supply Council of the State Department of Conservation and Economic Development for obtaining an increased subsurface water supply. This plan was approved, and defendant-borough objected thereto and appealed. There were two basic issues: (1) whether the proofs were insufficient to support the council's findings and (2) whether the Council exceeded its quasi-judicial function. The appellate court found against the appellants. It held that the evidence adduced at the hearing sustained the Council's conclusion that sources of water supply available to the company were inadequate to meet the public's demands. Furthermore, the methods used to adequately fulfill the water needs was peculiarly within the province of the Council. (Barnett-Florida)
W70-07617

4C. Effects on Water of Man's Non-Water Activities

HYDROLOGIC EFFECTS OF PRESCRIBED BURNING AND DEADENING UPLAND HARDWOODS IN NORTHERN MISSISSIPPI,
Forest Service (USDA), Oxford, Miss. Southern Forest Experiment Station.
S. J. Ursic.
USDA Forest Service Research Paper SO-54, 1970. 15 p.

Descriptors: *Burning, *Storm runoff, *Accelerated erosion, *Overland flow, *Peak discharge, Hydrologic aspects, Deciduous forests, Sediment yield, Rainfall-runoff relationships, Small watersheds, Watershed management, Soil erosion, Mississippi.
Identifiers: *Experimental watersheds, *Prescribed burning, *Post-fire erosion.

Reports 3-year results of treatment of two small watersheds consisting of burning the forest floor and deadening the hardwood overstory with a herbicide. Comparisons were against an untreated control watershed. Variables included stormflows, overland flows, peak discharges, and sediment yields. Most of the hydrologic effects were still evident three years after treatment. (Ursic-Forest Service)
W70-07517

THE TECHNICAL SERVICES DESIGN PROBLEM,
Northwestern Univ., Evanston, Ill.
For primary bibliographic entry see Field 06F.
W70-07547

POWELL V EDWARDS (CULVERTS UNDER RAILROAD EMBANKMENT HELD TO INCREASE SURFACE FLOW OVER LOWER LAND).

187 So 716-717 (Ala 1939).

Descriptors: *Alabama, *Culverts, *Embankments, *Surface runoff, Railroads, Engineering structures, Floods, Rainfall, Drainage, Obstruction to flow, Natural flow, Remedies, Judicial decisions, Legal aspects, Slopes, Ditches, Overflow, Flooding, Damages, Land clearing, Riddance (Legal aspects).

Defendant's railroad embankment was adjacent to plaintiff's lands but at a higher elevation. Surface waters coming from land above the embankment ran into a ditch along the embankment and were carried off. As land above the embankment was cleared, surface flow increased and the ditch could not accommodate the increased flow. Defendant therefore constructed two culverts under the embankment which caused an increased flow onto plaintiff's land and resulted in some flooding. Plaintiff sought damages alleging that defendant had impounded water and forced it to flow onto his land with greater force and volume than normal surface flow. The court acknowledged that plaintiff had no legal right to the continuance of the embankment structure which inhibited flow across his land. However, in holding for plaintiff, the court found that the normal surface flow had been increased by the clearing of the upper land, the collecting of the runoff, and the discharging of it through culverts onto plaintiff's land. Since natural drainage would have caused no flooding, plaintiff was entitled to damages. (Hubener-Florida)
W70-07610

NEW ORLEANS AND N E R RY V BURDETTE (OVERFLOW ONTO RIPARIAN LAND CAUSED BY REPLACEMENT OF TRESTLE).
183 So 915-916 (Miss 1938).

Descriptors: *Mississippi, *Culverts, *Excessive precipitation, *Obstruction to flow, Railroads, Engineering structures, Floods, Rainfall, Storms, Rainfall intensity, Embankments, Natural streams, Watercourses (Legal), Relative rights, Judicial decisions, Legal aspects, Water law, Overflow, Natural flow, Flooding, Riparian land, Natural flow.

Plaintiff owned a tract of land adjoining a railroad track. A natural stream ran across his land and under a trestle in the railroad embankment. Defendant railroad replaced the trestle with a small culvert. There had never been any overflow on plaintiff's land prior to the replacement, but after installation of the culvert flooding occurred on several occasions. After a very heavy rain and serious overflow, plaintiff sued for damages. The court held that the culvert should have been constructed with capacity sufficient to accommodate not only normal waters of the stream but also such overflow as past experience should cause the railroad to anticipate. The railroad was liable for any reasonable or unreasonable obstruction of the natural watercourse crossing the embankment. However, the railroad could not be held liable for damages caused by extraordinarily heavy and unprecedented rainfall. The court remanded the case for elimination of the damages attributed to injuries caused by the abnormally heavy rains. (Hubener-Florida)
W70-07612

4D. Watershed Protection

GROWING FOURWING SALTBUSH TRANSPLANTS FOR FIELD PLANTING,
Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.
Earl F. Aldon.
Forest Serv, USDA, Res Note RM-166, 1970. 3 p, 2 fig, 5 ref.

Descriptors: *Plant growth, *Vegetation effects, *Shrubs, *Land management, *Grass lands, Erosion control, Revegetation, Watershed management, New Mexico, Soil erosion.
Identifiers: *Ground cover, Atriplex canescens, Fourwing saltbush.

Seeds can be germinated in plant bands when air temperatures are around 65 deg F. Seedlings should be transplanted when soil moisture conditions are optimum. (Aldon-Forest Service)
W70-07515

AMERICAN SAND AND GRAVEL CO V RUSHING (STREAM BANK EROSION CAUSED BY EXCAVATION ON LOWER RIPARIAN LAND).
For primary bibliographic entry see Field 06E.
W70-07611

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

SIMULTANEOUS DETERMINATION OF CARBON AND OXIDABILITY OF ORGANIC COMPOUNDS IN NATURAL WATERS,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
For primary bibliographic entry see Field 02K.
W70-07201

COMPOSITION OF ORGANIC SUBSTANCES IN THE WATERS OF RESERVOIRS AND LAKES,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
For primary bibliographic entry see Field 02K.
W70-07202

BIODEGRADABLE DETERGENTS FOR THE TEXTILE INDUSTRY,
R. L. Huddleston.
American Dyestuff Reporter, Vol 55, No 2, p P52-P54, 1966.

Descriptors: *Detergents, Biochemical Oxygen Demand, *Biodegradation, Analytical techniques, Textiles, Fibers (Plant).
Identifiers: Foam measurement, Surface tension measurement, Bio-resistance.

Biodegradation studies carried out in commonly accepted test systems and by three analytical methods, including foam and surface tension measurements, demonstrated the biodegradability of primary straight-chain alcohol nonionic structures and the bio-resistance of straight- and branched-chain alkyl phenol nonionic structures. Although biodegradable detergents by their very nature must have a chemical oxygen demand (BOD), studies indicated that BOD values required by primary straight-chain alcohol nonionic products should not noticeably affect total BOD requirements of textile plant effluent waters. (Livengood and Robinson-North Carolina State Univ)
W70-07247

AN AUTOMATED METHOD FOR THE DETERMINATION OF BORON IN SEWAGE, SEWAGE EFFLUENTS AND RIVER WATERS,
Water Pollution Research Lab., Stevenage (England).
L. J. Lionnel.
Analyst, Vol 95, No 1127, p 194-199, 1970. 3 fig, 6 tab, 4 ref.

Descriptors: *Sewage, *Rivers, *Boron, *Sewage effluents, Analytical techniques, Colorimetry, Toxicity, Detergents, Water pollution sources, Instrumentation, Nitrates.
Identifiers: *Technicon AutoAnalyzer, Carminic acid, Perborates.

Reaction of boron with carminic acid in the presence of concentrated sulfuric acid produces a change in color of solution from red to blue. The maximum light absorption for the boron-carminic acid complex is at 590 to 610 nanometers. The colorimetric determination of boron content in sewage, sewage effluents, and river waters is accomplished by means of the Technicon AutoAnalyzer. The limit of detection is about 0.02 milligram of boron per liter, and reproducible results are obtained within the range of the element from 0.10 to 3.00 milligram/liter. The interference of nitrate is reduced by phenol to an acceptable level for aqueous samples containing less than 40 milligram/liter nitrogen. As boron can be toxic to certain plants at concentrations of a few milligram/liter, the method facilitates investigations of pollution caused by perborate bleaches used in detergent products. (Wilde-Wisconsin)
W70-07254

OBSERVATIONS OF EUTROPHICATION AND NUTRIENT CYCLES IN SOME COASTAL PLAIN ESTUARIES,
Johns Hopkins Univ., Baltimore, Md.
J. H. Carpenter, D. W. Pritchard, and R. C. Whaley.
Eutrophication: Causes, Consequences, Correctives, p 210-221. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 9 fig.

Descriptors: *Eutrophication, *Nutrients, *Cycles, *Estuaries, *Coastal plains, Nitrogen compounds, Phosphorus compounds, Temperature, Salinity, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Chlorophyll, Productivity, Phytoplankton, Zooplankton, Pennsylvania, New York, Seasonal, Reservoirs, Industrial wastes, Iron compounds, Sampling, Distribution, Flow rates, Rivers.
Identifiers: Chesapeake Bay, Potomac River, Transparency, Susquehanna River, Carbon fixation, Acartia, Microcystis aeruginosa.

Surveys in northern half of Chesapeake Bay and Potomac iver downstream from Washington, were made monthly for several years. Existing conditions and nutrient levels were determined as a basis for considering increase or reduction in nutrient discharges. Measured were temperature, salinity, dissolved oxygen, pH, alkalinity, chlorophyll, transparency, inorganic phosphate, total filtrate phosphate, total phosphate, nitrate, nitrite, ammonia, total nitrogen, productivity, and net phytoplankton and zooplankton counts. Susquehanna River samples, collected weekly during 1965-1966 monitored the input into upper Chesapeake Bay. A significant part of suspended sediments carried by the Susquehanna River is trapped in reservoirs in lower river reaches. Effects of treated sewage discharges are not observable in Chesapeake Bay below Baltimore. Phosphorus and nitrogen concentrations in estuarine part of the Potomac River during 1965 were not remarkably different from those in upper Chesapeake Bay. High concentrations of chlorophyll in the river below Washington are produced primarily by Microcystis aeruginosa. Zooplankton populations in the Potomac were frequently 3-fold to 5-fold greater than those in upper Chesapeake Bay. Decrease in dissolved oxygen in the lower layer shows that eutrophication may be more pronounced in the estuarine Potomac than phytoplankton counts and chlorophyll concentrations indicate. (See also W70-03975). (Jones-Wisconsin)
W70-07264

RESISTANCE OF FOUR FRESHWATER CRUSTACEANS TO LETHAL HIGH TEMPERATURE AND LOW OXYGEN,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 05C.
W70-07308

INSTRUMENTAL ANALYSIS FOR TRACE ELEMENTS PRESENT IN CHICAGO AREA SURFACE AIR,
Argonne National Lab., Ill. Radiological Physics Div.
S. S. Brar, D. M. Nelson, J. R. Kline, P. F. Gustafson, and E. L. Kanabrocki.
Journal of Geophysical Research, Vol 75, No 15, p 2939-2945, May 20, 1970. 7 p, 2 fig, 4 tab, 4 ref.

Descriptors: *Air pollution, *Trace elements, *Dusts, *Aerosols, *Illinois, Water pollution sources, Smog, Sampling, Data collections, Radiochemical analysis, Neutron activation analysis.
Identifiers: Chicago (Ill), Gamma-ray spectrometry.

On April 4, 1968, surface air particulates were collected on cellulose fiber filters simultaneously at 22 locations throughout the Chicago metropolitan area. A portion of each filter was irradiated with thermal neutrons in Argonne National Laboratory's CP-5 research reactor. The neutron-induced nuclides were analyzed by gamma-ray spectrometry. Twenty trace elements were identified in the surface air. The following elements, listed in decreasing order of concentration, were present: iron, chlorine, aluminum, zinc, manganese, sodium, bromine, vanadium, chromium, antimony, mercury, selenium, cerium, silver, cobalt, lanthanum, scandium, cesium, and europium. The average concentrations varied from 2400 to 0.12 ng/cu m air. (Knapp-USGS)
W70-07343

ATMOSPHERIC NITROUS OXIDE CONCENTRATIONS IN THE HUMID TROPICS,
National Center for Atmospheric Research, Boulder, Colo.
For primary bibliographic entry see Field 02K.
W70-07344

TRACE METAL CHARACTERIZATION IN AQUATIC ENVIRONMENTS BY ANODIC STRIPPING VOLTAMMETRY,
Bureau of Commercial Fisheries, Ann Arbor Mich., and Michigan Univ., Ann Arbor. Dept. of Environmental Health.
H. E. Allen, W. R. Matson, and K. H. Mancy.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 573-581, April 1970. 9 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Water analysis, *Trace elements, *Electrochemistry, *Anodes, Chemical analysis, Analytical techniques, Instrumentation, Nutrients.
Identifiers: Anodic stripping voltammetry, Electrolytic analysis.

Anodic stripping voltammetry may be used for quantitative determination of traces of metals in natural water. Less than 0.1 microgram/liter Pb can be measured in natural waters without preconcentrations of the sample. Metals from the sample are electrodeposited on composite mercury-graphite electrodes. Quantitative determination of the deposited metals is made by anodic stripping using a chronoamperometric technique. With short deposition times the kinetics of complexation of metals with naturally occurring complexing agents may be studied. The rates of exchange of complexing agents may be studied. The rates of exchange of complexed metals after the addition of acid or other metal cations also may be determined. (Knapp-USGS)
W70-07351

AUTOMATIC METHODS FOR DETERMINING NITRATE AND NITRITE IN WATER AND SOIL EXTRACTS,
Norsk Institutt for Vannforskning, Blindern; and Norges Landbrukshoegskole, Vollebekk.
A. Henriksen, and A. R. Selmer-Olsen.
Analyst, Vol 95, No 1130, p 514-518, May 1970. 5 p, 3 fig, 3 tab, 17 ref.

Descriptors: *Water analysis, *Pollutant identification, *Nitrates, *Soil water, *Colorimetry, Nitrites, Analytical techniques, Chemical analysis, Chemical reactions, Automation, Instrumentation, Surface waters.
Identifiers: Automatic nitrate analysis.

Automatic methods for determining nitrate and nitrite in fresh and sea water and in soil extracts with the AutoAnalyzer are described, together with details of the analytical systems. The methods are based on a modification of a manual procedure which consists of reduction of nitrate with copperized cadmium and, with the nitrite thus produced, diazotization of sulphanilamide, the product being coupled with N-1-naphthylethylenediamine to form a highly colored azo dye, which is measured at 520 nm. The methods are capable of analyzing twenty samples per hour. (Knapp-USGS)
W70-07358

REMOTE SENSING ANALYSIS OF WATER QUALITY,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Observation Sciences Dept.
Frank B. Silvestro.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 553-561, April 1970. 9 p, 8 fig, 1 tab, 6 ref.

Descriptors: *Water quality, *Monitoring, *Remote sensing, *Aerial photography, *Spectrometers, Photogrammetry, Infrared radiation, Surveys.
Identifiers: Oneida Lake (NY).

Water pollution studies demand monitoring systems capable of obtaining and analyzing large amounts of data to determine control and abatement measures. Spectral photography is the basis of one such system. Some parameters of interest for pollution studies can be obtained quantitatively from optical density in photographid imagery. Two examples illustrating the feasibility and utility of aerial photographic analysis are presented. Aerially obtained data of Oneida Lake, New York, indicate that the 'red' spectral region may be particularly useful for monitoring water quality. Aerial imagery obtained over a fiber industry effluent plume was analyzed to demonstrate how the data obtained can be used to study the mixing characteristics of receiving waters. (Knapp-USGS)
W70-07362

PRESENT WATER QUALITY IN THE CUYAHOGA RIVER,
Havens and Emerson, Cleveland, Ohio.
For primary bibliographic entry see Field 05B.
W70-07387

ANALYSIS OF MUNICIPAL AND CHEMICAL WASTE WATERS BY AN INSTRUMENTAL METHOD,
Dow Chemical Co., Midland, Mich. Analytical Science Lab.
V. A. Stenger, and C. E. Van Hall.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1755-1763, Oct 1968. 6 fig, 1 tab, 8 ref.

Descriptors: *Analyzer, Concentration, Interference, Oxidation reduction system, Waste water treatment, *Instrumentation.

An instrumental method based on a vapor phase oxidation mass reduction system utilizing carbon monoxide as a reaction product is discussed. Principle of operation and operating conditions is covered. The testing of samples includes primary and secondary municipal waste water, cellulose production wastes, and chemical wastes. Comparison between the instrumental (CO2D) and conventional (COD and TOC) tests are made. Results show comparable COD and CO2D values. A number of common compounds has shown results within 5% of the theoretical COD values. The results on some others particularly volatile compounds, such as phenol or acetone may be low by 10-15%. The presence of chloride (500 mg/l NaCl) raises results by about 10 mg/l at the 100-200 mg/l COD level. (Hancuff-Texas)
W70-07461

CHARACTERIZATION OF INDUSTRIAL WASTES BY INSTRUMENTAL ANALYSIS,
Ontario Water Resources Commission, Toronto.
H. A. Clarke.
Proceedings of the Industrial Waste Conference, 23rd, pt 2, p 26-34, 1968.

Descriptors: *Analytical techniques, *Industrial wastes, Chromatography, Spectrophotometry, Polarographic analysis, Metals, Organic compounds, Pesticide residues, Activated carbon.

Instrumentation and techniques used in a large chemistry laboratory for the analysis and characterization of industrial wastes are described. Instrumentation, basic principles and general methods of analysis are discussed including: polarography and atomic adsorption spectrophotometry for the analysis of metals, ultra-voilet and infrared spectrophotometry for the identification of some organics and gas and thin layer chromatography methods for the analysis of pesticide residues. In addition, examples of the application of this type of instrumentation to samples collected by carbon adsorption are described. (Sorber-Texas)
W70-07468

AUTOMATIC MEASUREMENT OF TOTAL OXYGEN DEMAND,
Dow Chemical Co., Midland, Mich.
Dennis A. Clifford.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 832-848, 9 fig, 7 tab, 6 ref.

Descriptors: *Chemical oxygen demand, Analysis, Waste water treatment, Instrumentation.
Identifiers: *Total oxygen demand (TOD), *TOD analyzer, Oxidation reaction, Calibration curve, Reaction efficiency, Plant effluent.

The need for a more accurate method of determination of oxygen demand is emphasized. To meet this need The Dow Chemical Company has developed the total oxygen demand analyzer (TOD). This instrument affords a very rapid and precise method for determination of oxygen demand. The developed method measures directly and quantitatively the amount of gaseous oxygen required to oxidize the nonaqueous constituents of a water sample. The reaction efficiency is very nearly equal to the theoritical without significant interference from the common sources. Because of the severity of oxidizing conditions, i.e., 900 deg C over platinum the method has been named Total Oxygen Demand method. The TOD analyzer is fully automatic in its functions of sampling and anlyzing, requiring a total time of 2 - 4 minutes per sample. Correlation of this method with the standard dichromate COD method has been very good on waste water analysis. The TOD analyzers have successfully operated over several instrument years as a device for laboratory and process analysis of water and waste water. (Shankar-Texas)
W70-07497

APPLICATION OF THE TOTAL CARBON ANALYZER FOR INDUSTRIAL WASTEWATER EVALUATION,
Texas Univ., Austin.
Davis L. Ford.
Proceedings of the Industrial Wastes Conference, 23rd, 1968. p 989-999, 4 fig, 5 tab, 12 ref.

Descriptors: *Biochemical oxygen demand, *Chemical oxygen demand, Industrial wastes, Instrumentation, Wastes, Waste treatment.
Identifiers: *Total organic carbon, Correlation.

The carbon analyzer provides a rapid and simple means of determining the organic levels in aqueous solutions. The total organic carbon, TOC, test is free of many of the variables which affect the BOD and COD analyses. In attempting to correlate TOC to BOD or COD certain limitations should be recognized, namely: a portion of COD is attributable to inorganics; the BOD and COD tests do not include resistant organic compounds; and the BOD test is susceptible to many variables. Theoretically, the COD/TOC ratio ranges from zero, when the organic material is resistant to degradation, to 5.33 for methane. Values cited from several industrial wastewaters range from 1.75 to 6.65. For waste streams of relatively constant character a COD-TOC relationship may be developed. It has been difficult to correlate BOD with TOC with industrial wastes, but relatevely good correlations have been obtained with domestic wastes. Ratios of five-day BOD to TOC of 1.35 - 2.62 have been reported. Both the COD/TOC and BOD/TOC ratios decrease during biological oxidation. (DiFilippo-Texas)
W70-07500

5B. Sources of Pollution

COPPER SULFATE IN FLOODED CRANBERRY BOGS,
Massachusetts Univ., East Wareham. Cranberry Experiment Station.
Karl H. Deubert, and Irving E. Demoranville.
Pesticides Monitoring Journal, Vol 4, No 1, p 11-13, June 1970. 3 p, 1 tab, 7 ref.

Descriptors: *Algicides, *Copper sulfate, *Cranberries, *Bogs, *Massachusetts, Path of pollutants, Water chemistry, Pesticides, Water pollution sources, Sampling, Water analysis, Data collections.
Identifiers: Cranberry bogs.

Cranberry bogs are treated with copper sulfate to control algal growth. In order to assess possible water pollution after release of treated floodwater into streams and ponds, the rate at which copper disappeared from the water after treatment was monitored in two separate bogs. In both bogs the concentration of copper 25 hours after application was higher than expected due to smaller volumes of floodwater. During the first 6 days after treatment, copper concentrations decreased rapidly, and after 10 days about 95% of the copper had disappeared. When floodwater was released about 4 weeks after treatment, the concentration of copper was at the same level found in the water prior to treatment. (Knapp-USGS)
W70-07156

PESTICIDE RESIDUES IN HALE COUNTY, TEXAS, BEFORE AND AFTER ULTRA-LOW VOLUME AERIAL APPLICATION OF MALATHION,
Communicable Disease Center, Savannah, Ga.
G. O. Guerrant, L. E. Fetzer, Jr., and J. W. Miles.
Pesticides Monitoring Journal, Vol 4, No 1, p 14-20, June 1970. 7 p, 2 fig, 6 tab, 5 ref.

Descriptors: *Water pollution sources, *Pesticide residues, *Texas, Pesticide kinetics, Pest control, Spraying, Public health.
Identifiers: *Malathion residues.

In ultra-low volume aerial sprayings of malathion for control of arthropod-borne encephalitis in 1967 in Hale County, Texas, the amount of malathion deposited was determined by measuring the amount found on exposed filter papers; the average concentration found was 1.5 mg/sq ft, or 65% of the applied dosage. The maximum concentration found in environmental waters was 0.5 ppm malathion, which decomposed with a half-life of 0.5 to 10 days, depending upon pH. Methods for collecting, transporting, and determining malathion residues are described. The chlorinated hydrocarbon residues present in the spray area were monitored also and found to consist mainly of DDT and BHC isomers. Most of the sampled waters contained less than 1 ppb of the individual chlorinated pesticides. (Knapp-USGS)
W70-07159

HYDROGEOLOGY AND WATER QUALITY STUDIES IN THE CACHE LA POUDRE BASIN, LARIMER AND WELD COUNTIES, COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
James P. Waltz.
Available from the Clearinghouse as PB-192 088, $3.00 in paper copy, $0.65 in microfiche. Natural Resources Center. Colorado State University, Partial Completion Report, June 30, 1969. 34 p, 7 fig, 2 plate, 2 tab, 9 ref. OWRR Project No A-001-COLO (7).

Descriptors: *Water quality, *Hydrogeology, *Colorado, *Water pollution sources, *Water pollution effects, Model studies, Analog models, Water chemistry, Mineralogy, Clay minerals, Runoff, Erosion, Groundwater movement, Surface waters.
Identifiers: Cache la Poudre basin (Colo).

The Cache la Poudre basin, Larimer County, Colorado, provides an ideal laboratory for study and documentation of the causes and effects of water quality deterioration. It has been possible to correlate downstream changes in quality of surface water and groundwater to environmental factors including both natural and man-induced conditions. Approximately half of the basin lies in mountainous terrain on the eastern slope of the Rocky Mountains in northern Colorado. Here, the effects of man's activities on the movement and quality of water have been relatively minor. Applications of geophysics, analog modelling techniques and studies of clay mineralogy were used in defining the geologic framework in the basin and evaluating the effect of geology on the quality of groundwater. (Knapp-USGS)
W70-07167

INDUSTRIAL APPLICATIONS OF STARCHES IN THE PAPER AND TEXTILE INDUSTRY,
For primary bibliographic entry see Field 05D.
W70-07239

BIODEGRADABLE DETERGENTS FOR THE TEXTILE INDUSTRY,
For primary bibliographic entry see Field 05A.
W70-07247

FACTORS INFLUENCING THE HERBICIDAL EFFICIENCY OF MCPA AND MCPB IN THREE SPECIES OF MICRO-ALGAE,
University of Strathclyde, Glasgow (Scotland). Dept. of Biology.
For primary bibliographic entry see Field 05F.
W70-07255

DISPOSAL OF LIQUID WASTES INTO COASTAL WATERS,
Battelle Memorial Inst., Richland, Wash.
W. L. Templeton.
Chemical Engineering Progress, Vol 66, No 2, p 45-50, 1970. 6 fig, 31 ref.

Descriptors: *Waste disposal, *Radioactive waste disposal, *Waste water (Pollution), Dispersion, Discharge (Water), Nuclear power plants, Nuclear wastes, Radioactivity effects, Fish, Predation, Oysters, Human pathology, Pesticides, Chlorinated hydrocarbon pesticides, Sea water, Coasts.
Identifiers: *England, Dilution, Strontium-90, Zinc-65, Cobalt-60, Porphyra umbilicalis, Half-life, Radionuclides, Windscale Plant (England), Bradwell Station (England), Ruthenium-106.

The danger to man from disposal of radioactive wastes is now probably better understood than any other industrial risk. Aside from the dose limits set by International Commission on Radiological Protection, the permissible discharge rates depend on the concept of critical populations, as well as degree of dilution, dispersion, and reconcentration of radionuclides. The external and internal exposure of both physical and biologic nature are additional factors delineating the disposal of radioactive wastes. The situation is comprehensibly illustrated as it now exists at the discharge points of English coastal waters. Exapmples include Ruthenium-106, Strontium-90, Zinc-65, Cobalt-60, and critical material, such as Porphyra umbilicalis, an edible seaweed, fish, oysters, and either the total body of man or his lower large intestine. The approach of the United Kingdom toward disposal of radioactive wastes is considered with reference to disposal of other pollutant materials. A similarity of chlorinated hydrocarbons with radionuclides is pointed out. (Wilde-Wisconsin)
W70-07278

ENHANCEMENT BY GLYCEROL OF PHOTOTROPHIC GROWTH OF MARINE PLANKTONIC ALGAE AND ITS SIGNIFICANCE TO THE ECOLOGY OF GLYCEROL POLLUTION,
Fisheries Research Board of Canada, Vancouver, (British Columbia). Vancouver Lab.
Joseph Y. Cheng, and Naval J. Antia.
Journal Fisheries Research Board of Canada, Vol 27, No 2, p 335-346, 1970. 2 fig, 2 tab, 16 ref.

Descriptors: *Pollutants, *Sea water, *Algae, *Marine algae, Cultures, Phytoplankton, Cytological studies, Cyanophyta, Chlorophyta, Chrysophyta, Rhodophyta, Testing, Ecology.
Identifiers: *Glycerol, Photoheterotrophic growth, Luminarin-type polysaccharides, Cryptophycea, Dinophycea, Baccilariophycea, Prymnesium parvum, Photoautotrophs, Chroomonas salina.

Eighteen species of marine phytoplankters were grown in axenic culture of sea water enriched in nitrate, orthophosphate, silicate, trace-metal ions, and vitamines, and buffered at pH 7.6-7.8. Aside from Prymnesium parvum and Chroomonas salina, none of the species showed growth on glycerol in the absence of light. Under illumination, glycerol stimulated the growth of 16 species particularly that Chrysophycea, Cryptophyceae, Phaedactylum tricornutum, Porphyridium cruentum, and Nannochloris oculata. The growth of some species was inhibited by glycerol at different concentrations. The effects of compound suggested its relation to photoheterotrophic growth. In some cases glycerol induced obvious cytological and metabolic changes. The ecological implications of glycerol pollution of sea water are discussed. (Wilde-Wisconsin)
W70-07280

THE LANGE-KUENTZEL-KERR THESIS.

Canadian Research and Development, March 1970. 8 p, 1 fig, 1 tab, 14 ref.

Descriptors: *Eutrophication, *Phosphorus, *Carbon, Bacteria, Algae, Symbiosis, Carbon dioxide, Nitrogen, Lakes, Estuaries, Nutrients, Detergents, Wisconsin, Lake Erie, Lake Ontario, St Lawrence River, International Joint Commission.
Identifiers: *Carbonaceous material, *Canadian phosphate detergent ban, Wyandotte Chemical Corporation, FMC Corporation, Soap and Detergent Association, Carboy trials, Canada, Nitrogen: phosphorus ratio.

Reports by W Lange (Nature Vol. 215, No. 5107: 1277-1278, Sep 17, 1967), L E Kuentzel (Journal Water Pollution Control Federation: 1737-1747, Oct 1969), and P C Kerr (unpublished) are cited defending the thesis that carbonaceous material, not phosphorus, is the factor controlling the process of eutrophication. As additional proof of the minor role of phosphorus and nitrogen in the growth of algae, the report includes the result of an experiment conducted in two small oligotrophic lakes in Florida. Addition of phosphate and nitrogen fertilizers to one of these organic matter-free lakes failed to alter significantly the trophic state of the lake and the density of planktonic organisms. The issue in question is of a far-reaching importance as it is relevant to the USA and Canadian government action restricting phosphate enriched effluents of soap and detergents into Erie and Ontario Lakes and the international section of the St Lawrence River. (Wilde-Wisconsin)
W70-07283

CONTRIBUTION TO THE RESIDENCE TIME OF SULFUR DIOXIDE IN A POLLUTED ATMOSPHERE,
Federal Board of Health, Berlin (West Germany). Inst. of Water Soil, and Atmospheric Hygiene.
Erich Weber.
Journal of Geophysical Research, Vol 75, No 15, p 2909-2914, May 20, 1970. 6 p, 4 fig, 6 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Sulfur compounds, *Dispersion, *Air pollution, Smoke, Thermal powerplants, Carbon dioxide, Mixing, Oxidation, Air pollution effects.
Identifiers: Sulfur dioxide, Atmospheric chemistry, Frankfurt am Main (Germany).

The atmospheric oxidation of sulfur dioxide was studied because of its importance in atmospheric pollution. Oxidation or absorption of sulfur dioxide is of interest, since it shortens the residence time and leads to lower ground-level concentrations. Initially the oxidation is quite rapid (almost 30% in about 100 min) for humidities above 70%. In Frankfurt am Main the concentration of air pollutants, wind direction and speed, air temperature, and relative humidity have been continuously recorded for several years. In certain cases short-term peaks (5 to 15 min) of carbon dioxide and sulfur dioxide concentrations can be defined as an in-

fluence of power station effluents. Carbon dioxide is almost inert, whereas the proportion of sulfur dioxide can decrease by oxidation or absorption while being transported through the atmosphere. Air quality measurements in Frankfurt am Main estimate a loss of almost 50% of the total sulfur content in a period of 20 min to 1 hour, depending on meteorological conditions. (Knapp-USGS)
W70-07333

INTERNATIONAL SYMPOSIUM ON ATMOSPHERIC TRACE CONSTITUENTS AND ATMOSPHERIC CIRCULATION.
For primary bibliographic entry see Field 02B.
W70-07336

TRACE ELEMENT CONCENTRATIONS IN THE TROPOSPHERE AND LOWER STRATOSPHERE.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 02K.
W70-07338

THE SEASONAL VARIATION IN THE CONCENTRATION OF STRONTIUM 90 IN RAIN AND ITS DEPENDENCE ON LATITUDE,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
D. H. Ehhalt, and G. Haumacher.
Journal of Geophysical Research, Vol 75, No 15, p 3027-3031, May 20, 1970. 5 p, 2 fig, 9 ref.

Descriptors: *Fallout, *Strontium radioisotopes, *Rainfall, *Latitudinal studies, *Seasonal, Sampling, Data collections, Statistical methods, Atmospheric physics, Air pollution, Tracers, Tracking techniques, Distribution patterns.
Identifiers: Sr-90 deposition.

Seasonal variations in Sr-90 deposition averaged over latitudinal belts 10 deg wide were calculated from monthly means obtained from a rainfall network and averaged over four years, 1963-1966 inclusive. Similar calculations were made for the Sr-90 concentration in rain and a deposition corrected for the seasonal variation in rainfall. In the northern hemisphere the seasonal variation of the Sr-90 concentration and the rainfall-corrected deposition exhibit the same systematic trend. A southern mode, which reached a maximum Sr-90 deposition in March, as well as a northern mode which does not reach a maximum before June were observed. The seasonal variations at intermediate latitudes change gradually from one pattern to the other. (Knapp-USGS)
W70-07340

DAILY VARIATIONS IN THE TRITIUM CONCENTRATION OF ATMOSPHERIC MOISTURE,
Gakushuin Univ., Tokyo (Japan). Dept. of Chemistry.
Kunihiko Kigoshi, and Kazuo Yoneda.
Journal of Geophysical Research, Vol 75, No 15, p 2981-2984, May 20, 1970. 4 p, 8 fig, 5 ref.

Descriptors: *Tritium, *Fallout, *Tracers, *Hydrologic cycle, Oceans, Sea water, Humidity, Tropical regions, Air circulation.
Identifiers: Japan.

Observed daily variations in the tritium concentration of atmospheric moisture collected in Tokyo from May 10 to June 2, 1966, and from July 12 to August 6, 1968, are presented. The relation between tritium concentration variations and the movement of air masses over Tokyo is discussed. High tritium concentrations indicate the arrival of continental air masses from the north, and low tritium concentrations indicate the presence of oceanic air masses. The tritium concentrations in tropical low-pressure air masses were nearly equal to that of surface ocean water. (Knapp-USGS)
W70-07341

CONCENTRATION PROFILES DOWNSTREAM FROM INSTANTANEOUS POLLUTION LOADINGS,
Midwest Research Inst., Washington, D.C., and Midwest Research Inst., Kansas City, Mo.
T. D. Bath, A. E. Vandegrift, and T. S. Hermann.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 582-595, April 1970. 14 p, 11 fig, 2 tab, 4 ref.

Descriptors: *Path of pollutants, *Tracers, *Dye releases, *Mathematical models, Diffusion, Mixing, Dispersion, Sorption, Streamflow, Turbulent flow, Eddies, Vortices.
Identifiers: Topeka (Kans).

Experimental investigations were carried out in the field to observe the downstream distribution of pollutants entering the stream instantaneously at a point. The observations were made on a small stream near Topeka, Kansas, over a distance of more than 10 miles from the point of injection of the pollutants. The data obtained are correlated well by a mathematical model that assumes that the basic mechanisms of pollutant transport are mixing by eddy diffusion and sorption due to stream boundary interactions. The distribution shows broadening of the peak area of concentration lowering of the peak, and 'tailing' as the pollutant moves downstream. A model was developed for pollutant dispersion in streams, pollutant transport in streams, and stability and conservation of the materials injected into the stream (sodium fluorescein and encapsulated rhodamine B dyes). (Knapp-USGS)
W70-07363

A METHOD FOR PREDICTING POLLUTANT TRANSPORT IN TIDAL WATERS,
Calif., University, Berkeley. Hydraulic Lab.
Hugo B. Fischer.
California University Water Resources Center Contribution No 132, Berkeley, March 1970. 143 p, 8 fig, 9 tab, 21 ref. Project W-165 UC-WRC; NSF Grant GK-3210.

Descriptors: *Computer programs, *Mathematical models, *Currents (Water), *Estuaries, *Path of pollutants, Mixing, Dispersion, Diffusion, Dissolved oxygen, Systems analysis, Rivers, Streamflow, Tides.
Identifiers: Pollutant transport model.

A numerical tidal pollutant-transport model is presented in two parts; part one models the tidal hydraulics of an estuary and determines tidal velocities and elevations; part two models the transport and dispersion of pollutants. The only input required is the tidal fluctuation of water surface at the estuary mouth and the geometry and frictional characteristics of the estuary. The model may be used to predict pollutant distributions from discharges in existing estuaries, or to determine effects on pollution caused by changing the estuarine geometry. (Knapp-USGS)
W70-07366

POLLUTION IN THE MISSISSIPPI RIVER,
Federal Water Pollution Control Administration, Chicago, Ill.; and Federal Water Pollution Control Administration, Dallas, Tex.
H. W. Poston, and W. C. Galegar.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 33-42, 1969. 10 p, 7 fig, 13 tab.

Descriptors: *Mississippi River, *Water pollution sources, *Water pollution effects, Pollutants, Solutes, Aquatic bacteria, Monitoring, Organic matter, Data collections, Water quality.

The Mississippi River, one of the world's largest watercourses, serves as a source of water for many uses: drinking, swimming, boating, commercial and sports fishing, navigation, and industrial water supply. Most sections of the river have experienced pollution problems. Federal enforcement conferences have been held at Minneapolis-St. Paul, St. Louis, and New Orleans. The New Orleans area, at present, is experiencing taste and odor problems in drinking water. Concentrations of organics, metals, and chlorides in the river are increasing. Through the water quality standards program, a state-federal partnership has been forged to improve management of water resources such as the Mississippi. (See also W70-07380). (Knapp-USGS)
W70-07384

PRESENT WATER QUALITY IN THE CUYAHOGA RIVER,
Havens and Emerson, Cleveland, Ohio.
George D. Simpson, and Lamont W. Curtis, Jr.
In: Water-1969, Chemical Engineering Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 64-74, 1969. 11 p, 8 fig.

Descriptors: *Water quality, *Water pollution, *Rivers, *Ohio, *Surveys, Water pollution sources, Water pollution effects, Dissolved oxygen, Biochemical oxygen demand, Industrial wastes, Municipal wastes, Coliforms, River basin development, Water resources development, Planning.
Identifiers: Cuyahoga River (Ohio).

A study of the water quality of the Cuyahoga River in Northeast Ohio was made. The purpose was to define the present water quality and to project future qualities by using alternative methods of treatment of waste water and flow augmentation. Extensive basic data collection included the chemical, physical, and biological characteristics. A dissolved oxygen model was constructed, and the alternative methods were investigated with respect to meeting the recommended water quality criteria. (See also W70-07380) (Knapp-USGS)
W70-07387

INTERNATIONAL CONFERENCE ON OIL POLLUTION OF THE SEA.
For primary bibliographic entry see Field 05C.
W70-07411

ESTUARINE POLLUTION IN THE STATE OF HAWAII. VOL. I: STATEWIDE STUDY,
Hawaii Univ., Honolulu. Water Resources Research Center.
Doak C. Cox, and Lawrence C. Gordon, Jr.
Technical Report No 31, March 1970. 151 p, 17 tab, 46 fig, 103 ref. FWQA Contract 14-12-446.

Descriptors: *Estuaries, *Hawaii, *Water pollution, Water quality, Water pollution sources, Pollutants.

Estuaries, for this study, are defined as either bays receiving fresh water discharge from land or tidal portions of stream mouths. Potential pollution of estuaries in Hawaii is related to land and estuarine useages. Existing water quality data for the estuaries is compared with water quality standards adopted for the state. For 89 estuaries identified, the water quality data is insufficient to form any basis for judgement as to relation to standards pertinent to 17 and that the quality does not meet the standards pertinent to 26. In 21 estuaries the quality definitely does not meet the standards. Some of the tolerances established in the standards are questionable, and assignments of some of the estuaries to water quality classes is questionable. A selected bibliography of 176 references is also included.
W70-07513

5C. Effects of Pollution

TEMPERATURE AND MANGANESE AS DETERMINING FACTORS IN THE PRESENCE

OF DIATOM OR BLUE-GREEN ALGAL FLORAS IN STREAMS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
Ruth Patrick, Bowman Crum, and John Coles.
Proceedings of the National Academy of Sciences, Vol 64, No 2, p 472-478, 1969. 2 tab, 10 ref.

Descriptors: *Streams, *Algae, *Diatoms, Temperature, Manganese, Cultures, Recirculated water, Nitrates, Phosphates, Sodium, Water pollution effects, Laboratory tests.
Identifiers: Green algae, Blue-green algae, Temperature experiments, Recycled water.

Trials conducted in culture boxes indicated that at an average temperature of 34-38C blue-green algae tend to replace diatoms. Both blue-green and green algae, commonly found in polluted waters, were favored by media with manganese concentration of only a few parts per billion. An average concentration of manganese of 0.02-0.043 milligram/liter in natural streams and 0.04-0.28 milligram/liter in recycled water experiment favored domination of diatom flora. Increase in nitrate and phosphate content of water failed to influence the flora of free-flowing streams, but promoted the growth of blue-green and green algae in recycled water of a low manganese content. (Wilde-Wisconsin)
W70-07257

THE UNSEEN PROBLEMS OF THERMAL POLLUTION,
Miami Univ., Fla. Inst. of Marine Science.
Donald P. de Sylva.
Oceans, Vol 1, No 1, p 37-41, 1969.

Descriptors: *Thermal pollution, Aquatic environment, Sewage, Industrial wastes, Water quality, Agriculture, Domestic wastes, Electric power plants, Fuels, Nuclear powerplants, Temperature, Killifishes, Marine microorganisms, Coasts, Oceans, Estuaries, Enzymes, Metabolism, Growth rates, Reproduction, Diseases, Food chains, Salinity, Alaska, Florida, Technology.
Identifiers: Atomic wastes, Temperature oscillations, Newfoundland.

Conventional power plants, using fossil fuels, raise the water temperature by about 10-30F. Nuclear power stations use much more water for cooling and return it to the environment at even higher temperatures. An increase of even one or two degrees may cause biological changes because of the many interacting factors between the organisms and the environment. The healthy upper limit of activity for most adult aquatic organisms is at about 90F; many temperate-water organisms cease activity at about 79F. Increased temperature is usually more detrimental during early development. Fresh water quality standards have been formulated, but arriving at standards for salt water is more difficult because of the complex nature of sea water. Adequate pollution control technology is available to industry and should be included in plant designs. While it is seldom possible to perform all the long-term studies needed to predict the varied effects of heated water, scientists have a number of simple but elegant principles of biology, chemistry, and physics, enabling rough but effective predictions of potential effects of water temperature increase upon the environment. (Jones-Wisconsin)
W70-07260

EUTROPHICATION IN NORTH AMERICA,
Washington Univ., Seattle.
W. T. Edmondson.
Eutrophication: Causes, Consequences, Correctives, p 124-149. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 6 fig, 4 tab, 70 ref.

Descriptors: *Eutrophication, *Nuisance algae, *Sewage, Water pollution sources, Water pollution effects, Phosphorus, Nitrogen, Chlorophyll, Productivity, Regional analysis, Reservoirs.
Identifiers: Nutrient budgets, Lake Sebasticook (Me), Lake Winnisquam (N H), Madison lakes (Wis), Lake Washington (Wash), Nuisance conditions.

Examples of artificial enrichment are given. Well-documented histories of the effects of artificial enrichment are not common. Case histories are available for four lakes or lake systems: Lake Sebasticook, Maine; Lake Winnisquam, New Hampshire; the Madison, Wisconsin, lakes; and Lake Washington, Washington. In each case, artificial enrichment occurred by sewage effluent input; Sebasticook also received large inputs of industrial wastes high in nutrients and organic matter. Artificial enrichment in all cases has resulted in lowered transparency, Myxophycean blooms and nuisance conditions of surface scum and odor. Diversion of sewage effluents has led to improved conditions in Lake Washington and the Madison Lakes Monona and Waubesa, although Lake Mendota appears to be deteriorating. One of the major features of the investigations of artificial enrichment in North American lakes is the development of nutrient budgets. This approach needs further development and refinement, and with continued development of bioassay techniques can be expected to aid future investigations. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07261

EUTROPHICATION, PAST AND PRESENT,
Yale Univ., New Haven, Conn.
For primary bibliographic entry see Field 02H.
W70-07262

BACTERIA IN LAKES: POPULATIONS AND FUNCTIONAL RELATIONS,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 02H.
W70-07263

OBSERVATIONS OF EUTROPHICATION AND NUTRIENT CYCLES IN SOME COASTAL PLAIN ESTUARIES,
Johns Hopkins Univ., Baltimore, Md.
For primary bibliographic entry see Field 05A.
W70-07264

EASTERN EUROPEAN LAKES,
Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
For primary bibliographic entry see Field 02H.
W70-07265

THE PROCESS OF EUTROPHICATION IN CENTRAL EUROPEAN LAKES,
Zurich Univ. (Switzerland); and Zurich Univ. (Switzerland). Cantonal Lab.
For primary bibliographic entry see Field 02H.
W70-07266

CRYSTALLIZATION OF EUTROPHICATION CONCEPTS IN NORTHERN EUROPE,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 07B.
W70-07267

THE ENRICHMENT OF STREAMS,
Waterloo Univ. (Ontario).
H. B. N. Hynes.
Eutrophication: Causes, Consequences, Correctives, p 188-196. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 40 ref.

Descriptors: *Eutrophication, *Streams, *Rivers, Primary productivity, Organic matter, Nutrients, Nitrogen, Phosphorus, Aquatic plants, Water pollution sources, Water pollution effects, Impoundments, Phytoplankton.
Identifiers: Enrichment, Water courses.

The term eutrophic, with its connotations of aging and evolution, cannot be properly applied to running water. Streams change along their length, increasing in discharge, width, depth, temperature, and transport of suspended matter and dissolved solids. Running water tends to be more fertile than standing water, but primary production is patchy due to turbulence and washout conditions. Community respiration is greater than photosynthesis in all but the most highly enriched streams. Input of sewage effluent enriches streams by increasing allochthonous organic matter near the effluent source and by increasing the concentrations of nutrient salts farther downstream. Additional nutrient inputs occur through leaching of agricultural soils (Wisconsin data--12 lb nitrate nitrogen and 0.6 lb phosphate/square mile per day). Land clearing, channelization and swamp drainage have converted streams into better producers. Stream floras tend to be opportunistic species (Myriophyllum, Potamogeton, Cladophora, Oscillatoria) which will invade newly-enriched substrates. Production of large rivers is dominated by planktonic diatoms and rotifers; turbidity appears to be major limiting factor. High temperatures, low discharges and low turbidities as found in impoundments are favorable for the development of Chlorophycean and Myxophycean flora and resultant increase of primary production. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07268

CHANGES IN THE ENVIRONMENT AND BIOTA OF THE GREAT LAKES,
Wisconsin Univ., Madison.
A. M. Beeton.
Eutrophication: Causes, Consequences, Correctives, p 150-187. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 15 fig, 1 tab, 76 ref.

Descriptors: *Sediments, *Eutrophication, *Great Lakes, Lake Michigan, Lake Superior, Lake Huron, Lake Erie, Lake Ontario, Nitrates, Water pollution sources, Water pollution effects, Physicochemical properties, Benthos, Fish populations, Dissolved solids, Dissolved oxygen, Sulfates.
Identifiers: Chlorides, Literature review, Green Bay, Saginaw Bay.

Although concern over changes in the Great Lakes has existed for many years, the idea that the lakes are undergoing accelerated eutrophication is recent. Environmental changes can be considered in three categories: pollution of inshore areas, long-term changes in open waters, and changes in sediments. On the basis of accepted physiocochemical characteristics, Lakes Superior, Michigan, and Huron are oligotrophic, Lake Eris is eutrophic and Lake Ontario is in an intermediate condition. Superior remains oligotrophic, except for localized pollution; changes in fish stocks are traceable to commercial fishing and predation by lamprey. Lakes Michigan and Huron have undergone changes involving dissolved oxygen, total dissolved solids and biota which indicate increasing eutrophy, especially in Green and Saginaw Bays. Lake Erie has shown major changes in limnological factors and biota; effects of increased pollution and eutrophication of Erie have spread to Lake Ontario. The most important changes apparently are those occurring in sediments owing to the contribution of large quantities of allochthonous materials resulting from urbanization and industrialization. Changes in sediments are important factors in the observed changes in limnological factors and fish populations. Abatement of present conditions in Lake Erie is theoretically possible. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07269

EUTROPHICATION INDICES AND THEIR RELATION TO OTHER INDICES OF ECOSYSTEM CHANGE,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 07B.
W70-07270

EUTROPHICATION OF ESTUARIES,
Woods Hole Oceanographic Insttition, Mass.
For primary bibliographic entry see Field 02L.
W70-07271

EUTROPHICATION AND CHANGES IN THE COMPOSITION OF THE ZOOPLANKTON,
Yale Univ., New Haven, Conn.
John Langdon Brooks.
Eutrophication: Causes, Consequences, Correctives, p 236-255. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 2 fig, 2 tab, 43 ref.

Descriptors: *Eutrophication, *Zooplankton, Feeding rates, Predation, Copepods, Daphnia, Lakes, Water pollution effects, Indicators, Phytoplankton.
Identifiers: *Literature review, Selective predation, Enrichment, Cladocera, Bosmina.

Truly herbivorous zooplankton of trophic importance are limited to the Cladocera and calanoid Copepoda. Enrichment of lake ecosystems leads to an increase in standing crop of phytoplankton and to a lesser degree, zooplankton. Increases in standing crops of zooplankton species are controlled or modified by several factors, including standing crop and size of phytoplankton, size-selective feeding by zooplankton, size-selective predation by planktivores and differential feeding effectiveness among zooplankton species. In the absence of planktivorous predators, larger forms (Daphnia, Mesocyclops, Epischura) will tend to dominate the zooplankton; size selective predation on zooplankton will result in dominance of smaller forms (Bosmina, Ceriodaphnia, Tropocyclops). Dominance of larger forms will tend to produce more 'oligotrophic' characteristics of the water; dominance of smaller forms will produce more 'eutrophic' characteristics. Sizes of zooplankters in Lakes Michigan and Erie supports this generalization. Species shifts within the genus Bosmina have been interpreted as indicating enrichment; they may, however, be caused or modified by predation or competition. Chemical enrichment may adversely affect populations of planktivorous fish, this change in turn will alter the composition of the zooplankton. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07272

ASIAN LAKES,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 02H.
W70-07273

BIOLOGICAL EFFECTS AND PERSISTENCE OF DURSBAN* IN FRESHWATER PONDS,
California Univ., Riverside. Dept of Entomology; and Bureau of Sport Fisheries and Wildlife, Davis, Calif.
For primary bibliographic entry see Field 02H.
W70-07276

BENTHIC FAUNA COLONIZATION OF A NEW RESERVOIR WITH PARTICULAR REFERENCE TO THE CHIRONOMIDAE,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-07279

THE LANGE-KUENTZEL-KERR THESIS.
For primary bibliographic entry see Field 05B.
W70-07283

RESISTANCE OF FOUR FRESHWATER CRUSTACEANS TO LETHAL HIGH TEMPERATURE AND LOW OXYGEN,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
J. B. Sprague.
Journal of the Fisheries Research Board of Canada, Vol 20, No 2, p 387-415, 1963. 15 fig, 2 tab, 40 ref.

Descriptors: *Crustaceans, *Isopods, *Temperature, *Dissolved oxygen, Oxygen, Acclimatization, Lethal limit, Oxygen requirements, Aquatic habitats, Resistance, On-site investigations, Aquatic animals, Mortality, Thermal pollution, Heat resistance, Heated water, Water temperatures.
Identifiers: Amphipods.

The crustaceans used were the isopod Asellus intermedius Forbes, and the amphipods Hyalella azteca (Saussure), Gammarus fasciatus Say, and Gammarus pseudolimnaeus Bousfield. Acclimation temperatures used before testing were 10 deg and 20 deg for all species, plus 30 deg for A. intermedius. Resistance to high temperature decreased with size in A. intermedius and G. fasciatus, over a weight-range of 1-35 mg. Small and medium-sized H. azteca were about equal in resistance. A rise in acclimation from 10 deg to 20 deg increased the temperature resisted for 24 hours by 1.9 deg in G. fasciatus, 1.3 deg in A. intermedius, and 0.5 deg in G. pseudolimnaeus, and apparently not at all in H. azteca. Estimates of the highest 24-hour lethal temperatures which could be obtained by raising acclimation were 34.6 deg for A. intermedius and G. fasciatus, 33.2 deg for H. azteca, and 29.6 deg for G. pseudolimnaeus. Differences in heat resistance between species are not as great as might be expected from their habitats. Temperature-resistance seems greater than necessary for survival in nature, especially for G. pseudolimnaeus, which is a cool-water species. Concentrations of oxygen causing 50% mortality in 24 hours were 0.03 mg/l for A. intermedius, 0.7 mg/l for H. azteca, 2.2 mg/l for G. pseudolimnaeus, and 4.3 mg/l for G. fasciatus. These oxygen values were for acclimation and testing at 20 deg, and changed for other combinations of temperatures. Resistance to low oxygen fits field observations fairly closely, and explains presence or absence of these species in polluted waters. (Speakman-Vanderbilt)
W70-07308

BODY CONDITION, WATER TEMPERATURE, AND OVER-WINTER SURVIVAL OF HATCHERY-REARED TROUT IN CONVICT CREEK, CALIFORNIA,
Bureau of Sport Fisheries and Wildlife, Bishop, Calif.
Norman Reimers.
Transactions of the American Fisheries Society, Vol 92, No 1, p 39-46, 1963. 1 fig, 3 tab, 14 ref.

Descriptors: Fish, *Rainbow trout, Trout, Fish hatcheries, *Fish management, *Fish stocking, *Overwintering sites, *Mortality, *Temperature, Spring, Fish behavior, Depreciation, Fish physiology, Water temperature, Fish establishment, California.
Identifiers: Convict Creek (California).

Summer stocked, catchable-sized, hatchery-reared rainbow trout (Salmo gairdneri) undergoing survival tests in controlled sections of a mountain stream repeatedly declined in condition (defined as weight in grams times 100,000 divided by the third power of the total length in millimeters) for several months after being stocked. In the spring months, when day length steadily increased and temperatures rose, spring recovery of trout vitality was expected. However, continuing mortality of the hatchery-reared trout suggested that they had depreciated since the previous summer to the extent that they responded adversely by depreciating further as the result of greater activity in the warming water. However, fall-stocked, hatchery-reared fish showed no appreciable rise in mortality until May, and three-fourths of the deaths recorded in that month were of fish stocked in August. Artificial selection of superior survivors for experimental breeding could be a useful step toward development of trout that are hardier in the wild. (Speakman-Vanderbilt)
W70-07309

SUPERSATURATION OF LAKE WATER WITH A PRECAUTION TO HATCHERY USAGE,
Toronto Univ. (Ontario). Dept. of Zoology.
Harold H. Harvey.
Transactions of the American Fisheries Society, Vol 96, No 2, p 194-201, 1967. 6 fig, 20 ref.

Descriptors: *Nitrogen, *Supersaturation, *Thermocline, *Hydrostatic pressure, Oxygen, Fish hatcheries, Lethal limit, Temperature, Dissolved oxygen.

Water temperature and dissolved oxygen were measured vertically in Cultus Lake on 20 occasions and dissolved nitrogen eight times during 1961. The results showed the water in the region of the thermocline became supersaturated markedly as a consequence of warming during the spring and summer. The excess gas was below the extent of surface mixing and was held in solution by the hydrostatic pressure. In mid-July, at a depth of 30 feet, oxygen was 126% and nitrogen 116% of air saturation. By mid-September at a depth of 50 feet, oxygen saturation was 94% and nitrogen 110% of air saturation. Oxygen was liberated by photosynthesis in the epilimnion and upper portion of the thermocline, and consumed in the lower part of the thermocline and the upper hypolimnion. Thus, nitrogen supersaturation could not be diagnosed by measurement of dissolved oxygen alone. Nitrogen supersaturation as low as 106% has been demonstrated to be injurious and lethal to fish. Thermocline water pumped to a hatchery will increase in nitrogen supersaturation with increased temperature. Use of thermocline water may be avoided by mixing epilimnion and hypolimnion waters to obtain the desired temperature. (Speakman-Vanderbilt)
W70-07310

DESTRUCTION OF FISHES AND OTHER ORGANISMS ON THE SOUTH TEXAS COAST BY THE COLD WAVE OF JANUARY 28 - FEBRUARY 3, 1951,
Texas Univ., Port Aransas. Inst. of Marine Science.
Gordon Gunter, and H. H. Hildebrand.
Ecology, Vol 32, p 731-736, 1951. 1 fig, 10 ref.

Descriptors: *Weather, *Cooling, *Fishkill, *Bays, Temperature, Mortality, Texas, Coastal areas, Acclimatization, Ecology, Thermal effects, Aquatic life.
Identifiers: Cold waves, Northers, Cold weather, Cold water.

The shallowness of Texas bay waters, their practically landlocked condition, and the rapidity with which cold northers strike the coast, are factors making the marine life of this area particularly subject to mortality from cold waves every few years. Since 1940, slight mortality was caused by cold waves in 1941 and 1949. Considerable damage was caused in 1947. The 1940 and 1951 episodes were catastrophic. Probably the 1940 instance was the most severe although the 1951 freeze was the hardest. Estimates made by biologists of the Game, Fish, and Oyster Commission of the amount of fish killed in 1951 range from 60 million to 90 million pounds. If the damaging cold waves are preceded by other freezes, their destructive effect is lessened. Some animals escape to deeper water if the onset of the cold wave is slow, and the rapidity with which the northers strike is a factor influencing the amount of mortality. (Speakman-Vanderbilt)
W70-07311

EFFECT OF TEMPERATURE AND PHOTOPERIOD ON THE SERUM PROTEINS OF THE RAINBOW TROUT, SALMO GAIRDNGRI,
Alberta Univ., Edmonton. Dept. of Zoology.
Herman M. Meisner, and C. P. Hickman, Jr.
Canadian Journal of Zoology, Vol 40, No 2, p 127-130, 1962. 1 tab, 14 ref.

Descriptors: *Temperature, *Rainbow trout, Acclimatization, *Proteins, Age, Sexual maturity, Fish physiology, Trout light.
Identifiers: Serum proteins, Photoperiod, Albumin, Globulin, Albumin globulin ratio.

The serum of 1- and 2-year-old Rainbow Trout, acclimatized at least 43 days to four conditions of temperature and daylength, was examined by paper electrophoresis. The albumin/globulin ratio was significantly greater in trout acclimated to 8 deg C than in those acclimated to 16 deg C. Photoperiod had no significant effect on the serum protein pattern. No effect of age or sex on serum proteins of fish kept under the same experimental condition was revealed. (Speakman-Vanderbilt)
W70-07312

EFFECTS OF INCREASED TEMPERATURES ON AQUATIC ORGANISMS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
John Cairns, Jr.
Proceedings of the 10th Industrial Waste Conference, Purdue University, Engineering Bulletin, Vol. 40, No. 1, 1956. p 346, 4 fig, 3 ref.

Descriptors: *Microorganisms, *Algae, *Dominant organisms, *Acclimatization, Diatoms, Thermal pollution, Temperature, Chemical properties, Ecology, Ecological distribution, Thermal effects.
Identifiers: Green algae, Blue-green algae, Heat death.

The population of microorganisms of a river is composed of the species that are best fitted to the local ecological conditions. Because there is a fierce competition for space, a species may be eliminated by an unfavorable, rather than lethal, factor, such as increased temperature. A mixed population of algae was taken from a normal healthy stream and gradually exposed to an increased temperature. At 20 deg C, a large number of species of diatoms were present and dominated the cultures. At 30 deg C, only two species of diatoms were numerous. Above 30 deg C, a few individual diatoms survived, but green algae predominated at 30 deg C to 35 deg C. In the range of 35 deg C to 40 deg C, blue-green algae were dominant. There are strong indications that the composition of the water is an important factor in heat death of aquatic organisms, since the chemical balance is usually quite different in heated waters from that of a typical stream. Microorganisms can be acclimatized to very high temperatures if the changes are small and gradual. (Speakman-Vanderbilt)
W70-07313

THE EFFECTS OF SUB-LETHAL LEVELS OF ZINC AND OF HIGH TEMPERATURE UPON THE TOXICITY OF A DETERGENT TO THE SUNFISH, LEPOMIS GIBBOSUS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
John Cairns, Jr., and Arthur Scheier.
Notulae Naturae, No 367 p 1-3 June 26, 1964. 3 p, 5 ref.

Descriptors: *Sunfishes, *Temperature, *Alkyl benzene sulfonates, Fish, *Detergents, *Toxicity, Thermal effects, Thermal pollution.
Identifiers: Zinc, Sub-lethal effects, Synergism.

Sunfish were exposed to alkyl benzene sulfonate detergent for 30 days at a concentration sufficient to cause marked gill damage. The fish were then exposed to both zinc chloride and increased temperature in separate tests. The exposure to alkyl benzene sulfonate does not cause a gross change in the tolerance of the fish to either zinc ions or increased temperature. No duplication of experiments was conducted. (Speakman-Vanderbilt)
W70-07314

EFFECTS OF THERMAL FLUCTUATIONS ON THE RELATIVE SURVIVAL OF GREENTHROAT DARTER YOUNG FROM STENOTHERMAL AND EURYTHERMAL WATERS,
Texas Univ., Austin. Dept. of Zoology.
Clark Hubbs.
Ecology, Vol 45, No 2, p. 376-379, 1964. 1 tab, 11 ref.

Descriptors: Spring waters, *Fish, *Darters, *Temperature, *Variability, *Thermal springs, Springs, Thermal effects, Thermal waters.
Identifiers: Adaptation, Stenothermal environment, Eurythermal environment, Thermal shock, Temperature fluctuations.

Adaptation of a stenothermal spring population of greenthroat darter young to thermal fluctuations is compared experimentally with that of eurythermal stream populations of the same species. Experiments were carried out on zygotes derived from gametes removed from wild-caught parents and the resulting developmental stages from egg development through late larvae. Results showed increased resistance to thermal shock with increased temperature fluctuations. (Speakman-Vanderbilt)
W70-07315

THE INFLUENCE OF WEIGHT AND TEMPERATURE ON THE METABOLIC RATE OF SUNFISH,
State Univ. of New York, Albany. Dept. of Biological Sciences.
JamesO'Hara.
Ecology, Vol 49, No 1, p. 159-161, 1968. 1 fig, 1 tab, 9 ref.

Descriptors: *Oxygen requirements, Oxygen, *Metabolism, Temperature, *Weight, *Sunfishes, Aquatic animals, Aquatic environment, Animal physiology, Fish, Fish physiology.
Identifiers: Pumpkinseed, Bluegill, Adaptation.

Oxygen consumption was determined for sunfish between 1.4 and 116.0 grams at 25 deg C and 30 deg C. Metabolic rates of smaller fish are less affected by temperature change than those of large fish. Interspecific comparison indicates that bluegills (Lepomis macrochirus) are better adapted to higher temperatures than pumpkinseeds (L. gibbosus). (Speakman-Vanderbilt)
W70-07316

THERMAL POLLUTION--BIOLOGICAL EFFECTS,
Water Pollution Control Federation, Washington, D.C. Research Committee.
C. C. Coutant.
Journal of the Water Pollution Control Federation, Vol 41, No 6, p. 1036-1053, 1969. 111 Ref.

Descriptors: *Aquatic life, *Ecology, Metabolism, Heat resistance, *Thermal pollution, Thermal discharges, Temperature, Waste assimilative capacity, Productivity, Performance, Growth, Animal physiology, Cold resistance, Fish physiology, *Animal behavior, *Biology, Reproduction.

This review summarizes the results of the most recent research concerning the biological effects of thermal pollution. Subjects covered specifically include heated discharges, reviews of temperature effects, thermal resistance, temperature selection, primary production, and waste stabilization. Also covered are the effects of temperature on reproduction, performance, growth, learning (conditioned response), and physiological activities, as well as the synergistic effects of temperature and other pollutants. (Speakman-Vanderbilt)
W70-07317

FURTHER STUDIES OF DEPTH DISTRIBUTION OF FISH, NORRIS RESERVOIR, TENNESSEE,
Tennessee Valley Authority, Norris.
Jack S. Dendy.
Journal of the Tennessee Academy of Science, Vol. 21, p. 94-104, 1944. 4 fig, 5 tab, 9 ref.

Descriptors: *Temperature, *Depth, *Reservoir fisheries, *Distribution, *Fish behavior, *Ecological distribution, Fish, Tennessee, Gill nets, Reservoirs, Bass, Drums, Walleye, Sauger, Fisheries, Fish populations, Aquatic habitats, Thermal stratification.
Identifiers: Norris reservoir, Clinch River, Shad.

Four gill nets, each 8 feet high and approximately 200 feet long were placed in Norris Reservoir at right angles to the shoreline, with one end at the water's edge and the other in deep water. Records were kept of species and weight of fish and depth at which each was caught. Data from 1944 and 1943 netting studies were in close agreement. In both studies fish were caught in water which contained too little oxygen to support them for extended periods. Distribution according to depth did not compare between the two studies as closely as did distribution according to temperature. Thus, temperature is of more significance than depth in the distribution of fishes. In normal years a close enough correlation exists between temperature and fish distribution to permit prediction of summertime distribution by making temperature measurements. (Speakman-Vanderbilt)
W70-07318

A FIELD AND LABORATORY INVESTIGATION OF THE EFFECT OF HEATED EFFLUENTS ON FISH,
Ministry of Agriculture, Fisheries and Food, London (England).
J. S. Alabaster, and A. L. Downing.
Fisheries Investigations, Series I, Vol VI, No. 4, 1966. 42 p, 21 fig, 15 tab, 35 ref.

Descriptors: *Fish, *Thermal pollution, *Heated water, *Temperature, *Fishkill, *Environmental gradient, Thermal power, Thermal stratification, Seasonal, Water circulation, Stress, Mortality, Trout, Rough fish, Carp, Aquatic life, Aquatic environment, Acclimatization, Behavior, Ecology, Water temperature, Heat resistance, Thermal stress, Fish barriers.
Identifiers: Roach, Perch, Gudgeon, Tench, Temperature gradient, Britain.

Tests in the laboratory and in British cooling-water outlets themselves have demonstrated that the increase in temperature of the water used by electricity generating stations for cooling purposed during the summer was often potentially lethal to trout and to the more sensitive species of coarse fish, such as roach, perch, and gudgeon, though not to tench and carp. Coarse fish (but not trout) were present in nearly all the rivers receiving these heated discharges, yet they were rarely seen to be killed, even close to the effluent outfalls. It seems likely that the fish avoid lethal conditions since they can perceive very small differences in temperature and are capable of selecting temperatures when tested in a gradient. It seems likely that, in rivers receiving heated effluents, the tendency for the hottest water to remain at the surface allowed the fish to survive in the cooler water below. In an experimental channel, fish were able to respond to lateral gradients of temperature or to increases in temperature and so avoid lethal conditions. On the two occasions when uncaged fish were found dead, many of the fish apparently escaped successfully, the majority killed being small gudgeon. These were also found to be vulnerable to rapid temperature changes in the experimental channel. (Speakman-Vanderbilt)
W70-07320

THE EFFECT OF LOW DISSOLVED OXYGEN CONCENTRATIONS ON TEMPERATURE - SALINITY TOLERANCE OF THE SAND SHRIMP, CRANGON SEPTEMPINOSA SAY,
Maine Univ., Orono.
Paul A. Haefner, Jr.
Physiological Zoology, Vol. 43, No. 1, p 30-37, 1970. 2 tab, 4 fig, 23 ref.

Descriptors: *Shrimp, *Temperature, *Dissolved oxygen, Oxygen, Mortality, Environmental effects, Estuarine environment, Estuaries, Aquatic habitats, Water temperature, Aquatic animals, Pollution, Water Pollution, Water pollution effects.

Identifiers: Sand shrimp.

Male and female (ovigerous and nonovigerous) sand shrimp, Crangon septemspinosa, were subjected to 12 temperature-salinity combinations at dissolved oxygen concentrations of 2-3 parts per million. Mortality data from this design were used to fit response contours for estimating the influence of low oxygen tension on the temperature-salinity tolerance of the species. There existed no possible temperature-salinity combinations at which 100 per cent survival of the adult sand shrimp could occur at those low oxygen tensions. Low oxygen tensions tend to shift the mortality contours toward lower temperatures and higher salinities, compared to those in aerated water. Female shrimp are more sensitive to low oxygen concentrations than are males, and berried females are most susceptable of the groups. Within an estuarine zone, any seaward or offshore migration to cooler, more saline water would be of survival value to the species. (Speakman-Vanderbilt)
W70-07321

THE EFFECTS OF BENTHAL DEPOSITS ON THE OXYGEN RESOURCES OF NATURAL STREAMS,
New York Univ., N.Y. Dept. of Civil Engineering.
Joseph A. Ogunrombi, and William E. Dobbins.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 538-552, April 1970. 15 p, 12 fig, 4 tab, 7 ref.

Descriptors: *Bottom sediments, *Sludge, *Decomposing organic matter, *Oxygen demand, *Dissolved oxygen, Water pollution effects, Biochemical oxygen demand.
Identifiers: Bottom sludge decomposition.

Two distinct processes taking place in benthal decomposition were investigated. These processes are: (a) The addition of organic material from the benthal deposits to the overlying water. This material then is carried downstream as part of the flowing biochemical oxygen demand load. (b) The removal of dissolved oxygen from the overlying water to satisfy the oxygen demands of benthal deposits at the aerobic top layer, and the immediate demands of the end-products of anaerobic decomposition. Mathematical expressions were developed for evaluating the magnitude of the rates by which the processes are measured. Laboratory experiments were conducted in continuous flow, completely mixed reactors. (Knapp-USGS)
W70-07349

TOXICOLOGICAL ASPECTS OF WASTE-WATER RECLAMATION--A PRELIMINARY REPORT,
California State Dept. of Public Health, Berkeley. Sanitation and Radiation Lab.
Alice Ottoboni, and Arnold E. Greenberg.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 493-499, April 1970. 7 p, 2 fig, 2 tab, 18 ref.

Descriptors: *Water pollution effects, *Water reuse, *Toxicity, *Reclaimed water, Waste water (Pollution), Sewage effluents, Pathology, Public health, Safety.
Identifiers: Wastewater safety.

Research on the toxicity of domestic wastewater to rats was conducted. Domestic waste water (unchlorinated activated sludge plant effluent) was provided as the sole water source to a group of young rats and the same community's potable water supply was given to a second, or control, group. Male rats in the experimental group gained more weight than control males; female rats given waste water had smaller adrenal glands than control females; and two male test rats developed massive tumors not seen previously in the rat strain at such a young age in the 18-wk test. (Knapp-USGS)
W70-07350

AQUATIC BIOLOGY ABSTRACTS, 1969.
For primary bibliographic entry see Field 10.
W70-07370

PROCEEDINGS FLORIDA'S ENVIRONMENTAL ENGINEERING CONFERENCE ON WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 05G.
W70-07371

RESEARCH TO SAVE AMERICA'S LAKES,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
Thomas E. Maloney, and Alfred F. Bartsch.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 278-280, 1969. 3 p.

Descriptors: *Eutrophication, *Lakes, *Water pollution control, *Reviews, Algae, Weeds, Ecology, Environment, Chemcontrol, Biocontrol, Integrated control measures, Physical control, Water quality.
Identifiers: *Eutrophication control.

The maturation process of a lake is called eutrophication and is greatly accelerated by man's activities which increase the nutrient input to the lake. These activities include agricultural development, urbanization, and the discharge of sewage, industrial waste, and treatment plant effluents to the lakes. With advancing of eutrophication, symptoms appear including: an increase in productivity of algae, waterweeds, and other living matter; the nitrogen and phosphorus concentrations increase; dissolved oxygen is depleted in the lower depths; the more desirable fish species become extinct, and rough fish species appear; and rooted vegetation begins to grow in from the lake margin and eventually fills the lake. (See also W70-07380). (Knapp-USGS)
W70-07393

CHRONIC EXPOSURE OF BLUE CRABS, CALLINECTES SAPIDUS, TO SUBLETHAL CONCENTRATIONS OF DDT,
Bureau of Commercial Fisheries, Gulf Breeze, Fla. Biological Lab.
Jack I. Lowe.
Ecology, Vol 46, No. 6, 1965, 1 tab, 4 ref.

Descriptors: *DDT, *Bioassay, Crabs, Water pollution effects, Chlorinated hydrocarbon pesticides, *Pesticide toxicity, *Growth rates.
Identifiers: Blue crabs, *Callinectes sapidus, Chronic exposure tests, *Molting changes.

Juvenile blue crabs, Callinectes, sapidus, were reared for 9 months in flowing sea water containing sublethal concentrations of DDT. Six were used as controls and 6 each were placed in .25 and .50 ppb DDT. Crabs fed, molted, and grew for 9 months in sea water containing 0.25 ppb (micrograms/liter) DDT but could survive only a few days in water containing DDT in excess of 0.5 ppb. (Sjolseth and Katz-Washington)
W70-07406

EFFECTS OF LAMPREY LARVICIDES ON INVERTEBRATES IN STREAMS,
Bureau of Commercial Fisheries, Marquette, Mich. Fisheries Biological Station.
Richard L. Torblaa.
U. S. Fish and Wildlife Service, Special Scientific Report-Fisheries No. 572, August, 1968. 13 p, 11 tab, 2 fig, 11 ref.

Descriptors: *Great Lakes, Lake Superior, Lake Michigan, Benthic fauna, Aquatic animals, *Aquatic populations, *Larvicides, *Lampreys, On-site data collections, *Invertebrates, *Aquatic insects, Resistance mortality.
Identifiers: Petromyzon marinus, *TFM, *Bay luscide, *Recovery, *Population changes.

The study was conducted on five streams tributary to Lake Superior and four tributary to Lake Michigan. Samples of the bottom fauna before and after chemical treatment revealed that most groups of aquatic organisms were not adversely affected by exposure to the lamprey larvicides TFM and Bay luscide. The total number of invertebrates was smaller 1 week after treatment than before treatment, increased somewhat by 6 weeks after treatment, and had returned to pretreatment levels 1 year after treatment. Aquatic insects were affected less than other organisms, and invertebrates were more severely affected and recovered more slowly in areas of sand and detritus than in riffle areas. (Sjolseth and Katz-Washington)
W70-07407

CONTROL OF APUS AND FAIRY SHRIMP IN HATCHERY REARING PONDS,
National Fish Hatchery, Tishomingo, Okla.
Russell G. Hornbeck, Warren White, and Fred P. Meyer.
Proceedings of the 19th Annual Meeting of the Southeastern Association of Game and Fish Commissioners, Tulsa, Oklahoma, October 10-13, 1965. p 401-404, 1 tab, 1 ref.

Descriptors: Channel catfish, Pest control, *Fish management, *Fish hatcheries, Bass, Turbidity, Growth rates, Shrimp, Chlorinated hydrocarbon pesticides, Toxicity, Bioassay, *Rotenone, Resistance, Water pollution effects, Plankton.
Identifiers: *Dylox, *Apus longicaudatus, *Streptocephalus texanus, Tishomingo, Oklahoma, *Fish production, Fairy shrimp, Parathion.

Single applications of 0.25 ppm Dylox effectively controlled the tadpole shrimp, Apus longicaudatus, in hatchery ponds without adverse effects on bass or channel catfish fry. Bass survival in treated ponds was boosted from 20 to 80 per cent by the Dylox treatment. Plankton populations in the treated ponds appeared unaffected. (Sjolseth-Washington)
W70-07408

EFFECTS OF POLLUTION ON ESTUARINE ECOSYSTEMS: I. EFFECTS OF EFFLUENTS FROM WOOD-PROCESSING INDUSTRIES ON THE HYDROGRAPHY, BOTTOM AND FAUNA OF SALTKALLEFJORD (W. SWEDEN),
Institute of Marine Research, Helsinki (Finland).
Pauli Bagge.
Merentutkimuslaitoksen Julkaisu/Havsforskningsinstitutets Skr. No. 228, p 3-118, 1969. 23 tab, 28 fig, 135 ref.

Descriptors: *Water pollution effects, Water pollution sources, *Estuarine environment, *Pulp wastes, Pulp and paper industry, *Sulfite liquors, Hydrography, *Benthic fauna, On-site investigations, Hydrogen ion concentration, *Water quality, Bioindicators, Biochemical oxygen demand, Bottom sediments, Chemical oxygen demand, Turbidity, Limnology, Benthic flora.
Identifiers: Saltkallefjord, Sweden, SWL, Littoral fauna, *Community distribution, *Animal diversity, *Estuarine ecosystems.

Saltkallefjord, Sweden has received effluents from a sulphite pulp and paper mill over a period of more than 80 years. In 1964 the discharge of effluents from factories into the fjord amounted to about 60,000 M3 per day. The main part of the wastes consisted of sulphite waste liquor (SWL), but the effluent contained also particulate material. Sewage was also discharged into the fjord. SWL was found to interfere with the pH, oxygen content, chemical and biochemical oxygen demand and transparency of the water. The influence of the effluents was revealed by (1) an increase in the organic content and bacterial activity in water and sediment (indicated by high BOD values), (2) a decline in the littoral fauna and vegetation, (3) low and fluctuating oxygen values, (4) macrofaunal communities differing from those reported in earlier investigations of the area, (5) high numbers of saprobic ciliates on heavily polluted bottoms, and (6), the predominance of limivorous (non-selective deposit feeding) deep-burrowing species in polluted localities. The selective effect of pollution on

the fauna was evident in both qualitative and quantitative changes, the distribution of the communities and the decreased diversity of the fauna in polluted areas. (See also W70-07410). (Sjolseth-Washington)
W70-07409

EFFECTS OF POLLUTION ON ESTUARINE ECOSYSTEMS: II. THE SUCCESSION OF THE BOTTOM FAUNA COMMUNITIES IN POLLUTED ESTUARINE HABITATS IN THE BALTIC-SKAGERAK REGION,
Institute of Marine Research, Helsinki (Finland).
Pauli Bagge.
Merentutkimuslaitoksen Julk/Havsforskningsinstitutets Skrift No. 228, p 119-130, 1969. 5 fig, 2 tab, 15 ref.

Descriptors: *Water pollution effects, Water pollution sources, Estuarine environment, *Benthic fauna, *Succession, *Bioindicators, Salinity, Oligochaetes, Climatic climax, Biological communities, Limnology, Pulp wastes.
Identifiers: *Estuarine ecosystems, *Macrofaunal communities, *Baltic Sea, *Skagerak, Sweden, Secondary succession, Climax communities, *Estuarine pollution, Polychaetes, Salinity zones.

The macrofaunal communities of five polluted estuaries situated in the Baltic--Skagerak region and representing different salinity ranges are compared. The secondary succession of the animal communities caused by pollution reveals to be a rapid process, especially in localities where the exchange of water is limited by sills, ice-cover or retarded estuarine circulation. The use of aquatic organisms and communities as indicators of clean water and various degrees of pollution is discussed. (See also W70-07409). (Sjolseth-Washington)
W70-07410

INTERNATIONAL CONFERENCE ON OIL POLLUTION OF THE SEA.

Report of Proceedings, held 7-9 October 1968 at Rome, Italy. Wykeham Press, Winchester, Great Britain, (1969). 414 p, append.

Descriptors: *Oil waste, *Oil-water interfaces, *Water pollution effects, *Water pollution control, *Internation Commissions, *International law, *Oceans, Oily water, Water pollution sources, Water pollution treatment, Legislation, International waters, Law of sea, Oceanography, Coasts.
Identifiers: *Oil pollution, *Coastal pollution, Oil spills, *Clean seas code.

This is the Third International Conference on Oil Pollution of the Sea: the first was held in London in 1953 and the second in Copenhagen in 1959. Individual papers were presented on the biological effects of oil pollution in the ocean and coastal waters, means of measuring and detecting oil pollution, and national and international control of oil pollution by technical and legal endeavors. The Clean Seas Code is suggested as a legal and practical means for achieving operational control of oil pollution in the sea. Eight resolutions are adopted and recommended in the appendix. (See also W70-07412 thru W70-07420).
W70-07411

THE IMPACT OF OIL POLLUTION ON SEA BIRDS IN EUROPE,
Rijksinstituut voor Veldbiologisch Onderzoek ten Behoeve van het Natuurbehoud, Zeist (Netherlands).
J. J. C. Tanis, and M. F. Morzer Bruyns.
International Conference on Pollution of the Sea, Rome, p. 67-74, Oct. 7-9, 1968.

Descriptors: Water pollution, Oil, *Water birds, Sea water, On-site investigations, *Water pollution effects, *Oily water, Oil wastes, Toxicity, Mortality.
Identifiers: North Sea, Baltic Sea, *Oil production.

Oiled birds are indicators of oil pollution of the sea. This paper deals with systematic surveilance made in several European countries from 1958-1968. Increasing pollution was noted along the North Sea and Baltic Sea coasts, especially in the autumn and early winter. The Mediterranean Sea had a constant but seldom concentrated pollution. Quantitative data for the Dutch-Belgian coast provided a monthly average number of victims per kilometer of 3.8 in 1962-1968 as compared with 1.9 in 1958-1962. The Common Scoter was the most stricken species. The actual number of birds that perish from oil pollution is much greater than the number reaching shore, possibly by a factor of 6-25. The regular occurrence of pollution has little effect on most bird groups, but if an important breeding, moulting, migration, or wintering area where the population of a particular species is concentrated is threatened by extensive oil pollution as from shipping disasters, the result could be quite different. A map giving a relative measure of oil pollution of European coastal areas for 1960-1968 is included. (See also W70-07411). (Harbert-Washington)
W70-07412

OIL POLLUTION AND THE CONSERVATION OF SEABIRDS,
Newcastle-upon-Tyne Univ. (England). Dove Marine Lab.
R. B. Clark.
International Conference on Oil Pollution of the Sea, Rome, p 76-112, October 7-9, 1968. 134 refs.

Descriptors: *Water birds, *Water pollution effects, Oil wastes, *Oily water, Sea water, mortality, Water pollution sources, Ducks, Rehabilitation, Animal diseases.
Identifiers: Oil tankers, Common guillemots, Brunnich's guillemots, Razorbills, Puffins, Long-tailed ducks, Eidel ducks, Common scoters, Oil pollution, *Biological effects, Torrey-Canyon, Long-term effects.

Spectacular disasters like the 'Torrey-Canyon' wreck cause the death of many seabirds, but chronic oil pollution of the sea is possibly more serious. Results to bird populations by both of these causes of mortality are reviewed and estimates of declines in certain populations are given. The immediate and long-term effects of oil contamination to seabird populations, especially to the auks which are the most seriously affected group of birds, are discussed in terms of replacement rates, egg laying and incubation, loss of waterproofing of the plumage, and loss of food organisms. The effects and subsequent rehabilitation of emaciation, lowering of body temperature, ingestion of oil, stress, and oil on plumage which are all caused by oiling are detailed. The feeding of, care of, and diseases acquired by birds while in captivity are mentioned as well as their subsequent return to the natural population. Rehabilitation has been relatively unsuccessful, and therefore, conservation of the most vulnerable species of seabirds is urged. (See also W70-07411) (Harbert-Washington)
W70-07413

BIOLOGICAL ASPECTS OF OIL POLLUTION,
Yamashina Inst. for Ornithology and Zoology, Tokyo (Japan).
Y. Yamashina.
International Conference on Oil Pollution of the Sea, Rome, p 112-114, October 7-9, 1968.

Descriptors: Water pollution, Sea water, Oil wastes, *Oily water, Water birds, Japan, *Water pollution effects, Emulsifiers, Waste disposal, Waste treatment, Water pollution control, *Mortality.
Identifiers: Guillemots, Sea green, Oil pollution.

The first marked damage in the seas around Japan by oil pollution was in 1954 to hatcheries. Oil pollution has increased since with increasing use of oil. In 1967, the Japanese Government ratified the international convention for prevention of pollution of the sea by oil proposed in 1954 and amended in 1962. Five cases of oil pollution by tankers occurred between October 1967 and June 1968. Two cases of oil pollution by earthquake and tidal wave damage occurred during 1968, but all were of small extent and were dispersed by spreading Seagreen, an emulsifier. The government has helped finance the construction of equipment for the disposal of waste oil at ports of Japan and the aquisition of guard boats to locate floating oil. Only one case of extensive damage to sea birds has been documented in Japan in which about 1,400 sea birds, chiefly guillemots, were washed ashore. (See also W70-07411) (Harbert-Washington)
W70-07414

OILING OF MARINE BIRDS IN SOUTH AFRICA,
Cape Town Univ. (South Africa).
M. K. Rowan.
International Conference on Oil Pollution of the Sea, Rome, p. 121-124, Oct. 7-9, 1968.

Descriptors: Sea water, *Water birds, Oily water, Diets, *Rehabilitation, Salmonella, Water pollution effects, *Mortality.
Identifiers: South Africa, *Jackass Penguin, Cormorant, Cape Gannet, Fuller's earth, *Oil pollution, Malnutrition.

Recent oil pollution along South Africa has not had noticeable effects upon inshore or highly pelagic feeders, but has resulted in extensive oiling of birds of the intermediate zones such as Cormorants, Cape Gannets, and Jackass Penguins. The first report of substantial numbers of oiled penquins was in April 1968. Between June and August, 1,7000 affected penquins were collected of which 400 died or were killed prior to treatment, and at least 350 died after treatment. Soaps, detergents, and sulphonated caster oil were found to have deleterious effects, whereas Fuller's earth was found to clean the birds with good success. Proper feeding is important. Oily fish such as pilchards produced good weight gains. Causes of mortality during treatment included malnutrition, fungal infections of the respiratory tract, and Salmonella infection. Captured penguins formed groups and release in such groups was thought to increase survival. (See also W70-07411) (Harbert-Washington)
W70-07415

THE SCIENTIFIC APPROACH TO THE PROBLEM OF OIL POLLUTION,
Solly Zuckerman.
International Conference on Oil Pollution of the Sea, Rome, p 148-159, Oct 7-9, 1968. 5 refs, 1 fig.

Descriptors: *Water pollution control, Oil wastes, *Oily water, Detergents, Water pollution effects, Water pollution treatment, Treatment, Methodology, Future planning, Safety factors.
Identifiers: *Oil spills, Torrey-Canyon, Oil pollution, *Safety precautions.

Many things were learned from the 'Torrey-Canyon' accident. Along with a diagram of the interrelationships of various chains of events which can follow major oil spills is a discussion of some of the lessons that were learned and the research being done as a result. This paper discusses the coordination of the attack upon the spillage, the importance of the location, methods for dealing with large spills, including mechanical containment and recovery, chemical dispersion, and sinking and burning the oil, measures for combatting coastal pollution, the enduring effects of oil pollution including its effects upon marine life and the effects of natural factors on the movement, dispersal, and destruction of oil at sea, the scale of effort, and the importance of prevention. (See also W70-07411) (Harbert-Washington)
W70-07416

DISPERSAL OF OIL SLICKS IN PORTS AND AT SEA,
Standard Oil Company of New Jersey.
Thomas W. Moore.

International Conference on Oil Pollution of the Sea, Rome, p 234-239, Oct 7-9, 1968.

Descriptors: Water pollution control, Oil wastes, Oily water, Surfactants, Dispersion, Detergents, Water pollution treatment, Methodology.
Identifiers: Corexit 7664, Oil pollution, Oil spills.

When an oil slick occurs it is preferable to remove the oil by mechanical means, but this is not always possible, and a new surfactant, Corexit 7664, has been developed as an effective dispersant which is non-toxic to marine life. Corexit can be sprayed onto an oil slick from boats, planes, or helicopters and has been highly effective with a wide variety of whole crudes and distilled petroleum fractions. It is of limited value with residuals and fractions with high viscosities. After being sprayed, either natural or induced agitation of the water surface is necessary. Then the oil is broken up into dispersed droplets encapsulated with Corexit and becomes a relatively stable oil-in-water dispersion. It is biodegradable and has been proven to be non-toxic to tropical fish and shrimp at 10,000 ppm for 24 hours. (See also W70-07411) (Harbert-Washington)
W70-07417

OIL POLLUTION IN SOUTH AFRICA,
G. H. Stander, and J. A. V. Venter.
International Conference on Oil Pollution of the Sea, Rome, p 251-259. 1968.

Descriptors: *Water pollution effects. Oil wastes, *Oily water, Detergents, *Water pollution control, Legislation, Mortality, Water pollution treatment.
Identifiers: *South Africa, *Oil pollution, Suez Canal, *Biological effects.

The closure of the Suez Canal has greatly increased the oil tanker traffic around South Africa. Accidents involving oil spillage during 1968 are reported. Examination of the polluted areas revealed bird mortalities, and in one case, a high mortality of sand hoppers, but little damage to other marine life. The cleansing of polluted areas by detergent is discussed. Tests in South Africa on various detergents showed all to be approximately the same order of toxicity. There are two main objectives in the formation of legislation, procurement of the powers to cope with willful or accidental spillage and the prevention of oil pollution, on which the South African government is working. (See also W70-07411) (Harbert-Washington)
W70-07419

THE POLLUTION OF SEA WATER BY DETERGENTS AS A CONTRIBUTORY CAUSE OF DELETERIOUS EFFECTS ON TYRRHENIAN PINE WOODS,
Pisa Univ. (Italy).
P. L. Lapucci.
International Conference on Oil Pollution of the Sea, Rome, p 381-388, Oct 7-9, 1968. 2 tab, 8 ref.

Descriptors: *Water pollution sources, Detergents, Chlorides, *Boron, Foaming, *Pine trees, Water pollution effects, Air pollution effects, Beach erosion, Domestic wastes.
Identifiers: *Tyrrhenian coast, *Anionic detergents.

Widespread and increasing deterioration of pine woods along the Tyrrhenian coasts of Italy has occurred in recent decades. Invariably, the pines closest to the sea have been the first to die. Detergents discharged into the sea from sewers and drains may play an important part since anionic detergents which don't decompose form a fine and persistent film on the sea surface and favor the absorption of other substances, such as oil, chlorides, and boron. During heavy sea swells in shallow areas, these detergents form foams which are blown onto the leaves of trees. (See also W70-07411) (Harbert-Washington)
W70-07420

VERTICAL MIGRATION OF ZOOPLANKTON IN WESTERN LAKE SUPERIOR,
Minnesota Univ., Duluth.
Wayland R. Swain, Richard W. Magnuson, Jack D. Johnson, Theodore A. Olson, and Theren O. Odlaug.
Available from the Clearinghouse as PB-192313, $3.00 in paper copy, $0.65 in microfiche. Report (1970). 57 p, 2 tab, 18 fig, 26 ref. OWRR Project A-022-MINN (1).

Descriptors: *Zooplankton, *Vertical migration, *Diumal distribution, Minnesota, Migration patterns, Distribution, Density stratification.
Identifiers: *Lake Superior, Planton indicators, Density distribution.

During the years of 1967, 1968, and 1969, studies were directed toward the vertical distribution of some of the principal zooplankters in Western Lake Superior. These analyses were based on sequential samples taken by means of the Hardy Plankton Indicator, an instrument developed for oceanographic work by the Scottish Marine Biological Association of Edinburgh, Scotland. Zooplankters were taken at regular intervals between one and forty meters of depth. In all instances, samples were taken on a twenty-four hour basis to include both periods of daylight and darkness. Organisms were filtered onto Number 60 Swiss Silk Grit Gauze (60 mesh per inch). Zooplankton collections were made on two principal routes; transect runs of 7.2 miles each direction from Knife River, Minnesota, to Two Harbors, Minnesota, and back again; and an equilateral triangular course of two and one-half miles in length in a fixed area. Significant differences were noted in the diurnal variations throughout the water mass. Highest concentrations in the surface samples were noted during the nighttime hours. Interesting shifts of density distribution were apparent throughout each of the years studied. Available data is correlated with existing thermal and light regime information.
W70-07510

THE CHARACTERISTICS AND POLLUTIONAL PROBLEMS ASSOCIATED WITH PETROCHEMICAL WASTES, SUMMARY REPORT,
Engineering-Science, Inc. Texas, Austin.
For primary bibliographic entry see Field 05D.
W70-07511

A CONTINUOUS RECIRCULATING CULTURE SYSTEM FOR PLANKTONIC COPEPODS,
National Marine Water Quality Lab., Kingston, R.I.
E. J. Zillioux.
Marine Biology, International Journal on Life in Oceans and Coastal Waters, Vol 4, No 3, p 215-218, November 1969. 1 tab, 1 fig, 16 ref. FWPCA Project 18050 OUC.

Descriptors: *Plankton, *Copepods, *Culture control, Cultures.
Identifiers: Acartia clausi, Acartia tonsa, Seawater (Synthetic), Culture (Continuous), *Culture (Copepod), Copepod (Feeding).

The calanoid copepods, Acartia clausi Giesbrecht and Acartia tonsa Dana, are maintained at high densities in continuous culture at 15 deg C. Synthetic sea-water medium is recirculated through filters and a foam tower which limits accumulation of dissolved wastes and various metabolites. The ciliate Euplotes vannus Muller is associated in culture with the copepods, and effectively controls bacterial population and accumulation of algal debris. The copepods graze upon the ciliates as well as upon the phytoflagellates Isochrysis galbana Parke and Rhodomonas baltica Korsten.
W70-07518

RESPONSES OF SOME ANADROMOUS FISHES TO VARIED OXYGEN CONCENTRATIONS AND INCREASED TEMPERATURES,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Donald Dorfman, and James Westman.
Available from the Clearinghouse as PB-192 312, $3.00 in paper copy, $0.65 in microfiche. Rutgers University, Water Resources Research Institute, Partial completion and termination report, June 1970. 75 p, 15 tab, 61 ref. OWRR Project B-012-NJ (1).

Descriptors: *Ecology, *Environmental effects, *Fish, *Dissolved oxygen, *Thermal pollution, Water quality, Growth rates.
Identifiers: *Anadromous fish, Thermal limits, Delaware River, American shad, Striped bass.

Striped bass, Roccus saxatilis, while perch, Roccus americanus, American shad, Alosa sapidissima, blueback herring, Alosa aestivalis, and alewives, Alosa pseudoharengus, were studied to determine their survial, responses and growth in reduced concentrations of dissolved oxygen. The upper thermal limits and tolerances were also determined for striped bass, white perch and alewives. Diurnal concentrations of dissolved oxygen were provided at levels similar to those occurring in the Philadelphia - Camden region of the Delaware River. Special tanks were constructed for establishing gradients of dissolved oxygen.
W70-07523

BENTHAL DECOMPOSITION OF ADSORBED OIL POLLUTANTS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
J. V. Hunter, H. L. Allen, and T. B. Shelton.
Water Resources Research Institute, Rutgers - The State University of New Jersey, May 1970. 31 p, 14 fig.

Descriptors: *Oil wastes, *Sludge, *Biochemical Oxygen Demand, Oil, Petroleum, Adsorption, Water pollution.
Identifiers: *Benthal oxygen demand.

The hydrocarbons found in motor oil and n-octadecane are degradable in a benthal deposit under aerobic conditions. The average rate of benthal oxygen demand observed, using acclimatized seed, was 5 gms/m2/day. The maximum observed rate of BOD exertion for adsorbed octadecane, with acclimatized seed, was, approximately, 0.085 mg O2/mg octadecane/day. The rate of benthal uptake is affected by the substrate concentration, the rate of water passage, and, initially, by the seed concentration. Sludge depth has no effect on the uptake rate. The effect of D.O. level is related to, but less significant than, the effect of water passage rate. The results suggest that much of the behavior of the adsorbed substrate type of deposit may be ascribed to the physical nature and especially to the surface, or interfacial, characteristics of the deposit itself. (Hunter-Rutgers)
W70-07528

TOXICOLOGY OF THIODAN IN SEVERAL FISH AND AQUATIC INVERTEBRATES,
Bureau of Sport Fisheries and Wildlife, La Crosse, Wis. Fish Control Lab.
Richard A. Schoettger.
Investigations in Fish Control, No 35, Jan 1970. 31 p, 16 tab, 2 fig, 62 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Pesticide toxicity, *Bioassay, Pesticide residues, Fish control agents, Fishkill, Fish physiology, Rainbow trout, Mortality, Lethal limits, Daphnia, Animal metabolism, Carbon radioisotopes.
Identifiers: *Thiodan, Metabolic pathways, Toxicology, *Endosulfan, Hatching success, Goldfish.

Thiodan, a chlorinated hydrocarbon insecticide, was tested against rainbow trout and their fertilized eggs, western white suckers, Daphnia magna, and

damselfly naiads. The median tolerance limits for trout and suckers ranged between 0.3 and 8.1 ppb and the fish were at least seven times more susceptible than the invertebrates. Toxicity was influenced by temperature, length of exposure, and alkaline pH. Exposures for up to 2 hours to 50 ppm of Thiodan were not toxic to fertilized trout eggs. The deposition and metabolism of Theodan residues in western white suckers, northern creek chubs, and goldfish were traced with the aid of carbon-14 labeled Thiodan, and chemical analyses of Thiodan in tissues. Residues occurred in the skin and muscles of fish exposed to acute and to multiple subacute concentrations. The death of fish which were poisoned subacutely was correlated with size and the lipid content of muscle. (Sjolseth-Washington)
W70-07548

A COMPARISON OF THE TOXICITY OF SOME COMMON INDUSTRIAL WASTE COMPONENTS TESTED INDIVIDUALLY AND COMBINED,
Virginia Polytechnic Inst., Blacksburg.
John Cairns, Jr., and Arthur Scheier.
Progressive Fish-Culturist, Vol 30, No 1, p 3-8, January 1968. 3 tab, 8 refs. U.S. Public Health Service Grants RRG-3965 and EF-00266.

Descriptors: Water pollution effects, *Bioassay, *Toxicity, Mortality, Industrial wastes, *Sunfishes, *Copper, Lethal limit, Potassium compounds.
Identifiers: *Synergism, *Antagonistic interaction, Lepomis macrochirus, *Acetaldehyde, *Acetic acid, *Acetone, *Cyanide, Zinc Chloride, 96-hr TLM Naphthenic acids, *Interactions.

Lepomis macrochirus were used in bioassays testing the toxicity of acetaldehyde, acetic acid, aceton, potassium cyanide, potassium dichromate, copper, naphthenic acids, and zinc chloride, both individually and combined. The TLM's were 53.0 ppm, 75.0, 8300, 0.18, 113, 1.25, 5.6, and 4.2 ppm, respectively. No dramatic interaction between the various components of the mixtures tested was evident. The authors stress the continued need of segregating certain waste components for intensive treatment before disposal or composting with other wastes. (Sjolseth and Katz-Washington)
W70-07549

A STUDY OF THE WATER ENVIRONMENT IN SOUTHEAST GEORGIA STRAIT IN ASSOCIATION WITH THE INTALCO ALUMINUM PLANT, II,
Washington Univ., Seattle. Coll. of Engineering.
E. B. Welch, D. W. Jamison, W. G. Williams, and R. F. Christman.
Special Report, Department of Civil Engineering, July 24, 1969. 180 p, 3 appendices, 6 refs, 13 tab, 17 fig.

Descriptors: Bioassay, *Water pollution effects, On-site investigations, Water quality, Intertidal areas, *Biological communities, *Benthic fauna, Invertebrates, On-site data collections, *Standing crop, Water analysis, Fluorides, Sockeye salmon, Bottom sediments.
Identifiers: *Aluminum plant, Georgia straits, Washington, *Community structure, Intertidal sand communities, Barnacles, Waste distribution.

The intertidal communities varied greatly but did not show a significant response to the Intalco Aluminum waste-water. The most noticeable deleterius effect upon invertebrate organisms was upon barnacles and hydroids within 20 feet of the plant diffuser. A reduction in species number was noticed in the benthic grab samples in the vicinity of the diffuser. Laboratory bioassays revealed no acute effect up to 33% waste on juvenile sockeye salmon and Dungeness crabs. Authors concluded that an effect of the Intalco waste-water on invertebrate fauna is detectable only in the immediate vicinity of the diffuser. (Sjolseth and Katz-Washington)
W70-07550

REGISTRATION AND CLEARANCE OF CHEMICALS FOR FISH CULTURE AND FISHERY MANAGEMENT,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
Elwood A. Seaman, H.W. Hays, C. R. Walker, R. A. Johnson, and J. G. Cummings.
Fish and Chemicals - A Symposium held at the 99th Annual Meeting of the American Fisheries Society, New Orleans, La., Sept 12, 1969. 73 p, 16 tab.

Descriptors: *Fish control agents, *Fish management, Public Health, Fish diseases, Fish toxins, *Piscicides, *Herbicides, 2, 4 - D, Copper sulfate, Diquat, Antimycin A, Rotenone, *Regulation, Administrative agencies, *Legal aspects.
Identifiers: *Fish culture, *Anaesthetics, Cyanide, Petroleum oil.

This symposium contains 4 papers. Three of these, by R. E. Johnson, J. G. Cummings, and H. W. Hays deal with the registration and clearance of chemicals used in fish culture and management. The fourth paper, by C. R. Walker on the problems in clearance and registration of chemicals used by fish culturists and fishery biologists, discusses the problem, gives information and current status of use and registration of chemicals. The chemicals discussed are classified into the groups: Herbicides, piscicides, disinfectants and pest control other then fish, external and internal therapeutic agents and anesthetics. (Sjolseth and Katz-Washington)
W70-07551

EFFECTS OF DECAYING BARK ON INCUBATING SALMON EGGS,
International Pacific Salmon Fisheries Commission, New Westminister (British Columbia).
J. A. Servizi, D. W. Martens, and R. W. Gordon.
Progress Report No 24, 1970. 28 p, 6 figs, 10 tab, 19 refs.

Descriptors: Bioassay, Water pollution effects, *Bark, *Sockeye salmon, *Mortality, *Sphaerotilus, Water pollution sources, Decomposing organic matter, Water quality, *Oxygen requirements, *Biochemical oxygen demand, Hydrogen sulfide, Hydrogen in concentration, *Fish eggs, Fish toxins, *Fishkill, Incubation, *Gravels.
Identifiers: *Bark pollution, *Decay processes, Incubation times.

The effect of bark contamination on salmon spawning grounds was assessed in laboratory tests on sockeye salmon (Oncorhynchus nerka) eggs and alevins. Bioassays showed that chemical toxicity of materials leached from bark of Douglas fir, Lodgepole pine, Engelmann spruce and Alpine fir was not a factor influencing survival under the conditions tested. However, abundant growths of Sphaerotilus occurred on bark during initial stages of decay, causing severe mortalities among sockeye eggs and alevins owing to suffocation. In gravel-filled incubation boxes, contamination of gravel with bark caused significant reductions in survival from egg to fry at bark concentrations of 10% by volume, but 1% bark concentrations did not influence survival. Mortalities were attributed to blockage of intragravel water flow by bark particles. Possible effects of various oxygen concentrations on size and emergency timing of fry were discussed and limiting amounts of bark recommended. (Sjolseth and Katz-Washington)
W70-07552

5D. Waste Treatment Processes

NEUTRALIZATION OF HIGH FERRIC IRON ACID MINE DRAINAGE,
Federal Water Quality Administration, Norton, W. Va. Norton Mine Drainage Field Site.
Roger C. Wilmoth, and Robert B. Scott.
Available from the Clearinghouse as PB-192 087, $3.00 in paper copy, $0.65 in microfiche. Paper presented before Third Symposium on Coal Mine Drainage Research, Mellon Institute, Pittsburgh, Penn, May 19, 1970. 28 p, 5 fig, 17 tab, 7 ref. FWQA Project 14010---5/70.

Descriptors: *Acid mine water, *Water pollution treatment, *Neutralization, Chemical reactions, Water chemistry, Iron, Limestone, Acidity, Acids, Alkalinity, Lime, Costs.
Identifiers: Soda ash, Acid mine water treatment.

The Norton Mine Drainage Field Site of the Federal Water Quality Administration has been conducting research on the feasibility of acid mine drainage treatment using lime, limestone, and soda ash neutralization. The Norton research facility is located at Norton, West Virginia, on the banks of Grassy Run--a small, heavily polluted stream of which an estimated 90% of the water flow is from abandoned mines. Tests were run on identical samples of Grassy Run water to determine the quality of the supernatant when the sample was neutralized to various pH's. Lime, limestone, and soda ash were each tested as the neutralizing agents. All 3 neutralizing agents--lime, limestone, and soda ash--can meet the pH 6.5, net alkalinity, iron below 7.0 ppm criteria with relative ease. The major differences between soda ash neutralization and lime or limestone neutralization are that soda ash produces low hardness, low calcium, high sodium, and high cost, whereas all other chemical parameters are comparable between the 3 neutralizing agents. (Knapp-USGS)
W70-07149

WASTEWATER REUSE - A SUPPLEMENTAL SUPPLY,
Los Angeles County Sanitation District, Calif.
John D. Parkhurst.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA3, Paper 7318, p 653-663, June 1970. 11 p, 1 fig, 5 tab.

Descriptors: *Water reuse, *California, Water supply, Water requirements, Water resources development.
Identifiers: *Los Angeles (Calif).

Los Angeles County obtains water from any sources. Completion of the California Water Project in 1971-72 and the second barrel of the Owens River Aqueduct in 1972 will ensure adequate supplies until about 1990. These high quality imported waters will also enhance the quality of treated wastewater for subsequent reuse. Much of this better quality water will be used directly for irrigation or percolation to the underground. Ultimately, demineralization of wastewater may be practical on a large scale, since processes now under development appear competitive with alternative sources of supply. While a significant quantity of wastewater is suitable for treatment and reuse, it should be considered in its proper role - as a supplemental supply. (Knapp-USGS)
W70-07151

COTTON BLEACHING AND DYEING WASTES - A SPECIFIC SOLUTION AND A GENERAL PRESCRIPTION,
W. B. Hart.
Industrial and Engineering Chemistry, Vol. 49, No. 3, p 81-82, 1957.

Descriptors: *Aeration, *Dialysis, Alkalinity, Color, Biochemical Oxygen Demand, Chlorine, *Waste water treatment, Textiles.
Identifiers: *Cotton bleaching wastes, *Cotton dyeing wastes, *Water Scrubber tower, *Upward flow sedimentation tank, *Kier scouring, *Soil treatment bed, *Recovery (Waste), *Biological filtration, *Mercerizing wastes, *Dyehouse wastes, Suspended matter, pH, Percolating filter, Decolorizing sodium hydroxide, Chemical Coagulation, Sodium peroxide.

The characteristics of waste waters from bleaching and dyeing of cotton that require correction are high alkalinity, suspended matter, color, and BOD. The pH value of the bleaching waste water is first reduced with flue gas, which has previously been cleaned in a water scrubber tower. The waste water is then treated in an upward-flow sedimentation tank before filtration through a two-stage percolat-

ing filter with recirculation of effluent. Waste waters from the cleaning and decoloring of foreign cotton goods by kiering with sodium peroxide are highly colored and strongly alkaline; these waste waters can be decolorized with Cl2 before mixing with other bleaching wastes. Waste waters from the kiering of cotton to remove oil and grease are strongly alkaline, contain suspended matter, are red-brown in color, and have a high BOD. One method of treatment of these waste waters involves adjustments of the pH value to 6.0-6.5 with a cheap acid, aeration, upward-flow sedimentation, and flow across a gently sloping soil treatment bed to reduce the BOD. NaOH can be recovered economically from mercerizing waste waters by dialysis; when the volume of waste is large, it should first be concentrated. Waste waters from the dyeing process may contain suspended dye matter or true color. They can be treated by chemical coagulation, upward-flow sedimentation, and biological filtration. (Robinson and Livengood-North Carolina State Univ)
W70-07237

INDUSTRIAL APPLICATIONS OF STARCHES IN THE PAPER AND TEXTILE INDUSTRY,
A. Harsveldt.
Chemistry and Industry, No. 51, p 2062-2070, 1961.

Descriptors: *Biochemical oxygen demand, Textiles, *Waste water treatment, Pulp and paper industries.
Identifiers: *Starch, *Textile mill wastes, *Starch hydroxyethyl ethers, Starch hydroxypropyl ethers, Warp sizing, Desizing.

The uses of various forms of starch in the paper and textile industries are described. The use of hydroxyethyl and hydroxypropyl ethers of starch lowers the BOD of the resulting waste waters, the reduction in BOD being greater the higher degree of substitution of the starch product. A reduction in BOD of 70% could be obtained by a degree of substitution of 0.1. (Robinson and Livengood-North Carolina State Univ)
W70-07239

EVALUATION METHOD OF COMMERCIAL ENZYMIC DESIZING AGENTS,
U. Miyaoka, and M. Masunaga.
Journal of the Society of Textile Cellulose Industries of Japan Vol. 9, p 605-608, 1953.

Descriptors: *Analytical techniques, Chemical analysis, *Solubility, Waste water treatment.
Identifiers: *Starch, *Dyehouse wastes, Desizing, Warp sizes.

The solubility of simple starch size was determined in order to estimate the transition of a sizing agent into a soluble state. This simple method was applied to compare commercial enzymic desizing agents and also to detect the residual starch on fabrics within plus or minus 5% error. (Livengood and Work-North Carolina State Univ)
W70-07245

THE BULL-RUSH EATS PHENOL,
Reinhold Kickuth.
Translated from Deutscher Forschungsdienst, Vol 14, No 14, p 1-2, 1969. Northeastern Wisconsin Regional Planning Commission, Appleton. Typescript, 3 p, 1969.

Descriptors: *Bulrush, *Phenols, *Waste water treatment, *Pilot plants, Biochemistry, Water pollution, Tertiary treatment, Water conservation, Industrial wastes, Organic compounds, Nutrients, Metabolism, Toxicity, Domestic wastes, Aromatic compounds, Potable water.
Identifiers: *Bodensee (Germany), Lake Constance, Salicylic acid.

A new process for treatment of sewage plant waste streams in which higher plants convert the dissolved and colloidal materials, is under investigation in a pilot plant at Lindau, Germany. Observations were confirmed by quantitative basic research at Gottingen University (Germany) that intensive purification of waste-loaded water takes place in the sphere of influence of certain water plants. These have the ability to take up substantial quantities of organic compounds in addition to their normal requirement of mineral nutrients and to utilize these in their metabolism. They can even absorb materials which generally have a toxic effect. It was demonstrated that the bulrush can take up phenol, salicylic acid, and other aromatic compounds and metabolize them. The route of degradation of phenol, similar to certain microorganisms, is oxidation and scission of the aromatic ring. The load factor, the seasonal dependence of the degradation output, suitable tanks, and the nature of th intermediate fraction are being investigated. The immediate goal is the inclusion of bulrushes in the design calculations of water conservation programs. (Jones-Wisconsin)
W70-07259

DISTRIBUTION OF FUNGI IN A WASTE-STABILIZATION POND SYSTEM,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
W. Bridge Cooke, and George S. Matsuura.
Ecology, Vol 50, No 4, p 689-694, 1969. 1 fig, 3 tab, 5 ref.

Descriptors: *Fungi, *Oxidation ponds, *Sewage, Yeasts, Sampling, Sewage treatment, Self purification, Decomposing organic matter, Cultures, Population.
Identifiers: Lebanon (Ohio).

Plating and enrichment culture techniques were used to determine fungus population in a small waste stabilization pond system. The entire system and an adjacent stream yielded 212 species of filamentous fungi and yeasts. A year after the establishment of the system, the number of fungal and yeast species increased 5-fold and the number of colonies 200-fold. The results of the study indicated that fungi are among saprobic organisms that play an important part in the removal of organic wastes from water stabilization ponds. (Wilde-Wisconsin)
W70-07274

TREATMENT OF MINE DRAINAGE BY INDUSTRY IN PENNSYLVANIA,
Pennsylvania Dept. of Health, Harrisburg. Div. of Mine Drainage.
Walter N. Heine, and Ernest F. Giovannitti.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA3, Paper 7362, p 743-755, June 1970. 13 p, 5 fig, 2 tab, 2 ref.

Descriptors: *Acid mine water, *Waste water treatment, *Pennsylvania, *Water pollution control, Neutralization, Aeration, Sludge disposal, Legislation.
Identifiers: Mine drainage treatment, Acid mine drainage.

Polluting mine drainage from active mines can and is presently being successfully treated by almost 200 coal companies in Pennsylvania. The increasing level of pollution from coal mining in Pennsylvania resulted in the passage of stricter laws to regulate mining. In order to comply with these laws, mining companies are being required to construct and operate mine drainage treatment plants whenever pollution exists or is anticipated from a mine. All of the treatment plants constructed to date involve various combinations of neutralization, aeration, settling, and sludge disposal. Although further development of mine drainage treatment technology will undoubtedly bring about further refinement and sophistication of treatment, the plants now operating are successfully preventing polluting discharges as defined by the State regulatory standards. (Knapp-USGS)
W70-07346

SOIL SYSTEMS FOR LIQUID WASTE TREATMENT AND DISPOSAL: ENVIRONMENTAL FACTORS,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
Warren A. Schwartz, and Thomas W. Bendixen.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 624-630, April 1970. 7 p, 8 tab, 4 ref.

Descriptors: *Soils disposal fields, *Ultimate disposal, *Soil-water-plant relationships, Soil water movement, Water levels, Waste water treatment, Groundwater movement, Soil physical properties, Soil properties.
Identifiers: Soil disposal-systems.

A number of environmental factors were investigated for their effect on the treatment potential and hydraulics of soil disposal systems. The effect of depth to groundwater was to restrict both hydraulic longevity and treatment efficiency in shallow (2 to 4 ft) systems, probably because of limited reaeration opportunity in the unsaturated zone. The adverse effects of low temperature on treatment and hydraulics can be overcome by (a) achieving biological maturity in the soil system during warmer periods, (b) using a highly adsorptive soil medium, or (c) prenitrification of the waste. Vegetation on the soil surface greatly increases hydraulic longevity and supplements treatment efficiency through plant assimilation of nitrogen and phosphate. (Knapp-USGS)
W70-07348

BUILDING FOR THE FUTURE--THE BOSTON DEEP-TUNNEL PLAN,
Camp, Dresser and McKee, Boston, Mass.
Charles A. Parthum.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 500-510, April 1970. 11 p, 3 fig, 2 tab.

Descriptors: *Storm runoff, *Water storage, *Water pollution control, *Massachusetts, Sewers, Tunnels, Sewage disposal, Cities, Costs, Cost-benefit analysis.
Identifiers: Boston (Mass).

A deep-tunnel storage plan has been proposed to prevent pollution due to discharge of wastewater overflows and mixed wastewater and stormwater from the combined sewers of Boston and adjacent municipalities. Other methods such as complete sewer separation, chlorination tanks, and holding tanks were considered, but the deep-tunnel system appeared most economical. Construction costs were estimated at $430 million and capitalized operation and maintenance at $66 million. The proposed system consists of 17.2 miles of 33-ft diam deep tunnels in a radial pattern, a pumping capacity of 2,400 cfs and a 45,000-ft ocean outfall with diffusers. The system is designed to handle runoff from the 15-yr-frequency storm of 24-hr duration within 2 days, without surcharging, and the maximum recorded storm for Boston if surcharging is permitted. (Kmapp-USGS)
W70-07364

WATER -- 1969.
For primary bibliographic entry see Field 05G.
W70-07380

FREEPORT SULPHUR COMPANY'S POLLUTION CONTROL PROGRAM (SPECIAL REFERENCE TO OFFSHORE),
Freeport Sulphur Co., Belle Chasse, La.
For primary bibliographic entry see Field 05G.
W70-07386

IN SITU TREATMENT OF RIVERS AND STREAMS,
Dow Chemical Company, Walnut Creek, Calif.
Melvin F. Katzer.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by Amer-

ican Institute of Chemical Engineers, New York, p 81-85, 1969. 5 p, 1 fig, 10 ref.

Descriptors: *Water pollution treatment, *Suspended load, *Desilting, *Turbidity, Flocculation, Sediment control, Biochemical oxygen demand, Coliforms, Solutes, Adsorption, Clays, Silts.
Identifiers: Potomac River.

Laboratory and field tests were performed to show that muddy rivers and streams can be successfully treated with synthetic flocculants to remove the suspended solids. This process can be used to protect or improve the aesthetic appearance and recreational value of a stream or a body of water into which the stream flows. (See also W70-07380) (Knapp-USGS)
W70-07388

REVERSE OSMOSIS PROCESS FOR WATER REUSE APPLICATION,
Office of Saline Water, Washington, D.C.
K. C. Channabasappa.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 140-147, 1969. 8 p, 9 fig, 10 tab, 2 ref.

Descriptors: *Water reuse, *Reverse osmosis, *Water costs, Economics, Reclaimed water, Desalination, Desalination processes, Industrial wastes, Industrial water.
Identifiers: Industrial water reuse.

Technical details of the reverse-osmosis waste water treatment process and an economic evaluation of its application to the treatment and reuse of secondary sewage effluents or industrial water wastes are presented. Under present conditions, costs range from 20 to 35 cents/1,000 gal; advances in reverse-osmosis membrane technology in the near future are expected to lower these costs further. (See W70-07380) (Knapp-USGS)
W70-07389

THE ENGINEERING EVALUATION OF REVERSE OSMOSIS AS A METHOD OF PROCESSING SPENT LIQUORS OF THE PULP AND PAPER INDUSTRY,
Sulphite Pulp Manufacturers Research League, Inc., Appleton, Wis.; and American Standard, New Brunswick, N.J.
A. C. F. Ammerlaan, and A. J. Wiley.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 148-155, 1969. 8 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Water reuse, *Reverse osmosis, *Pulp wastes, *Water costs, Reclaimed water, Economics, Sulfite liquors, Byproducts, Water pollution control, Membrane processes.
Identifiers: Pulp waste processing.

Evaluation of data from the first of six, 3-mo. trials of a large (50 to 100,000 gal/day) pilot scale reverse osmosis processing unit operating at various pulp mills and on different types of spent liquors, confirms 90% or better recovery of high quality water and rejections of dissolved organics and inorganics at the 90 to 99% level in the concentrate. The unit operated 46% of available time to process 1,260,000 gal. of calcium base sulfite wash water containing 1% solids and concentrated to the 7 to 16% range. Problems encountered included reliability of mechanical equipment, pumps, pH control, membrane module failures and processing problems for control of gypsum scale, and membrane fouling with silicate-pitch complexes. All problems except life of membrane modules were found capable of being handled satisfactorily. Membrane equipment life requires further development by suppliers. Costs were found to be well below other methods of concentration such as by evaporation. (See also W70-07380) (Knapp-USGS)
W70-07390

INSTALLATION AND OPERATION OF UPWARD-FLOW CLARIFIERS AT WORKS OF THE LICHFIELD RDC,
K. G. Pullen.
Water Pollution Control, Vol 68, No 6, p 635-638, Nov-Dec 1969. 3 fig.

Descriptors: *Sewage treatment, *Design, Installation, Cost, Waste water treatment.
Identifiers: *Upflow clarifiers, Surface loading, Backwashing, Clarifiers.

During a two and one-half year period clarifiers were installed at three small sewage treatment plants (7000-24,500 Imperial gallons/day). In two cases the clarifiers were installed in the humus tanks while in the other case a separate unit was constructed. Information concerning the design, installation and performance of the clarifiers is given. Satisfactory effluents were produced at surface loadings of less than 20 Imp gallons/hour. The use of small stone or pea gravel in the bottom of the clarifier resulted in the need to backwash daily; while if larger medium, 3/4 to 1 inch were used backwashing was necessary at two-week or longer intervals. Construction and installation cost data are given. (DiFilippo-Texas)
W70-07445

DISPOSAL OF TITANIUM PROCESS WASTES,
National Lead Co., Sayreville, N.J.
Lincoln Peschiera, and Frank H. Freiherr.
Journal Water Pollution Control Federation, Vol 40, No 1, p 127-131, Jan 1968.

Descriptors: *Industrial waste, *Disposal, *Acid, Waste water treatment, Concentration (Composition), Neutralization, Slaking.
Identifiers: *Titanium dioxide pigment, Barging, Sea disposal, Sulfuric acid, Ferrous sulfate.

Titanium dioxide in an inert, non-toxic white pigment produced in various areas for use in the paint, paper, plastic, drug, and ceramic industries. Wastes generated in the process consist of dilute sulphuric acid, soluble salts (primarily ferrous sulfate), and insoluble materials (particularly silica) and unrecovered titanium dioxide. The described plant has three disposal methods: (1) disposal at sea, consisting of a rubber lined shore storage facility for collecting, and barges for disposal of acidic wastes and slurries at sea, (2) waste treatment facilities consisting of a neutralization facility which titrates to a pH of 4.0 and subsequently discharges to the Middlesex County Sewage Authority collection system, (3) a lagoon system providing clarification and cooling of coolants and wash water with pH adjustment if required followed by discharge to Raritan river estuary. Better than 99.5% of the waste generated is recovered in the disposal system. The entire operation requires 6 mgd of fresh water from deep-wells and 44 mgd of brackish water from the Raritan River estuary. (Hancuff-Texas)
W70-07446

DYNAMIC MODEL OF THE ANAEROBIC PROCESS,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
John F. Andrews.
Journal of Sanitary Engineering Division, American Society of Civil Engineers, Vol 95, No SA1, p 95-116, February 1969. 18 fig, 31 ref. FWA WP-00622.

Descriptors: *Anaerobic digestion, *Simulation analysis, *Inhibition, *Hydrogen ion concentration (pH), Anaerobic bacteria, Laboratory tests, Waste water treatment.
Identifiers: *Dynamic model, *Volatile acid concentration, *Process stability, Pactorus.

Process stability has been the major problem associated with the anaerobic digestion process. A dynamic model which utilizes an inhibition function to predict the failure of an anaerobic digester was presented. The key features of the model were: (1) The use of an inhibition function to relate volatile acid concentration and specific growth rate for the methane bacteria; and (2) consideration of the un-ionized acid as the growth-limiting substrate and inhibiting agent. The consideration of the un-ionized acid as the inhibiting agent resolves the conflict between volatile acid inhibition and pH inhibition because the concentration of un-ionized acid is a function of both total volatile acid concentration and pH. The model was kept as simple as possible by assuming that there was no lag phase, organism death, endogenous respiration, substrate utilization for maintenance energy, or inhibition by products. Experimental evidence from laboratory studies and evidence from the bacteriological literature were presented in support of the model. Simulation studies, utilizing a digital-analog simulation program (PACTORUS), of both batch and continuous flow systems provided additional evidence by predicting results commonly observed in the field during the start-up, or failure, or recovery of anaerobic digesters. The simulation studies should be considered as only semiquantitative as reliable values of the growth parameters were not available. (Calwardi-Texas)
W70-07448

ATTACHED GROWTH OF SPHAEROTILUS AND MIXED POPULATIONS IN A CONTINUOUS-FLOW APPARATUS,
Rutgers - The State Univ., New Brunswick, N.J.
F. F. Dias, Norman C. Dondero, and M. S. Finstein.
Applied Microbiology, Vol 16, No 8, p 1191-1199, Aug 1968. 5 fig, 7 tab, 17 ref.

Descriptors: *Sphaerotilus, *Slime, Nitrogen, Dissolved oxygen, Carbohydrates, Flow rates, Sewage bacteria.
Identifiers: *Sewage fungus, Continuous-flow apparatus, Mixed cultures, Pure cultures, Sludge bulking.

The term 'sewage fungus', also called slime infestation, describes a group of organisms comprised of bacteria and protozoa, as well as true fungi, that grow attached to surfaces in polluted water courses. Probably the most important form of slime infestation is caused by Sphaerotilus. Sphaerotilus has also been implicated in sludge bulking in the activated sludge process. The environmental factors which allow Sphaerotilus to grow in successful competition with other members of the biota was investigated by the use of continuous-flow vessels. Twelve vessels were innoculated with S. matans, sewage, or both and the effects of NH_4Cl, organic nitrogen, dissolved oxygen, and gluose concentrations as well as flow rate are described. Increased levels of gluose did not result in the selection of Sphaerotilus over other organisms indicating that sludge bulking due to Sphaerotilus is due to nitrogen deficiency rather than increased carbohydrates. Initial low dissolved oxygen, 1 mg/l, favored the growth of Sphaerotilus in mixed populations but not in pure cultures. At low NH_4Cl concentrations 0.2-1 mg/l, Sphaerotilus were dominant in slimes; but when the concentration was increased to 5 mg/l this dominance was no longer evident. Increases in organic nitrogen concentrations gave increased slime growth but led to no dominance. (DiFilippo-Texas)
W70-07449

CONTINUOUS OXIDATIVE ASSIMILATION OF ACETIC ACID AND ENDOGENOUS PROTEIN SYNTHESIS APPLICABLE TO TREATMENT OF NITROGEN-DEFICIENT WASTE WATERS,
Oklahoma State Univ., Stillwater.
A. F. Gaudy, Jr., K. C. Goel, and Elizabeth T. Gaudy.
Applied Microbiology, Vol 16, No 9, p 1358-1363, Sept 1968. 4 fig, 1 tab, 12 ref. FWQA Grant WP 00325.

Descriptors: *Nitrogen, *Activated sludge, Deficient elements, Chemical oxygen demand, Ammonium compounds, Waste water treatment, Industrial wastes.

A modification of the activated sludge process for the treatment of nitrogen deficient wastes involves the nitrogen supplement not being added to the waste water. Instead the waste is contacted with an acclimated biomass and the carbon source is removed by oxidative assimilation. The biological solids are settled and a portion subjected to endogenous respiration in the presence of extra-cellular nitorgen. A laboratory scale unit operating on this principle was fed 1000 mg/l of acetic acid. Aeration time of waste water was twelve hours. A portion of the sludge was aerated in the presence of ammonium sulfate for twelve hours. Ratios of influent chemical oxygen demand (COD) to nitrogen studied were: 30:1, 50:1, and 70:1. COD removal efficiencies of 87 to 91 per cent were observed. Ammonia nitrogen in the effluent ranged from 0 to 4 mg/l. The study represents the most critical test to which the process has been subjected and suggests that the process may provide cost savings and curtailment of nitrogen leakage in effluents. (DiFilippo-Texas)
W70-07451

GREASE REMOVAL AT A MUNICIPAL TREATMENT FACILITY,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr, and Carlos T. de Navarra, Jr.
Journal of the Water Pollution Control Fed., Vol 41, No 5, Part 2, p R142-R154, May 1969. 6 fig, 7 tab, 17 ref.

Descriptors: *Waste water treatment, *Biochemical oxygen demand, *Lipids, *Suspended solids, Chemical oxygen demand, Municipal waste, Activated sludge.
Identifiers: *Grease, Primary treatment, Secondary treatment, Thin layer chromatographs.

An activated sludge municipal waste treatment facility was studied to determine the concentration and types of grease in treated and untreated waste waters, to determine typical grease removal efficiencies, and to compare grease removal with other performance parameters. Laboratory samples were analyzed for biochemical oxygen demand, suspended solids, and volatile suspended solids. The wet extraction technique determined the grease concentration and thin layer chromatography determined the lipid classes present in the total grease (lipid) extract. The data showed that: (a) the average influent grease concentration varied with biochemical oxygen demand and chemical oxygen demand, but not suspended solids, and was an average of 147 mg/l (0.11 lb/day/cap); (b) only biological treatment altered the relative proportion of the lipid classes; (c) primary clarifiers removed approximately 45% of both grease and suspended solids; (d) the secondary system removed 78% biochemical oxygen demand, 74% grease and 69% suspended solids; and (e) overall plant removal efficiencies were 84% grease, 82% suspended solids, and 85% biochemical oxygen demand. (Waid-Texas)
W70-07452

EVALUATION OF THE LOADING PARAMETERS FOR ANAEROBIC DIGESTION OF CANE MOLASSES DISTILLERY WASTES,
All-India Inst. of Hygiene and Public Health, Calcutta.
I. Radhakrishnan, S. B. De, and B. Nath.
Journal of the Water Pollution Control Federation, Vol 41, No II, R 431-440, Nov. 1969. 1 fig, 3 tab, 11 ref.

Descriptors: *Anaerobic digestion, *Industrial wastes, *Performance, Biochemical oxygen demand, pH, Efficiencies, Pilot plants, Waste treatment.
Identifiers: *Volatile acids, *Loading rates, *Detention time, *Distillery wastes, Molasses waste.

The effect of loading rate variations on the anaerobic treatment of a molasses distillery waste was investigated. Four 10 liter laboratory digesters were loaded at 0.094 lb BOD/day/cu ft while detention times varied from 4 to 20 days. Results showed that better digestion was accomplished with diluted feed as compared with concentrated raw waste feed as high volatile acids concentrations and low pH values developed with the raw feed. An upper limit of 241 mg/l of sulfides was reported as compared to an inhibitory upper limit of 100 mg/l previously reported. Results from increased loading rate studies indicated that a loading rate of 0.188 lb BOD/day/cu ft could be maintained using a raw waste feed while a loading rate of 0.226 lb BOD/day/cu ft could be maintained using a diluted waste feed. BOD removal efficiency ranged from 80 to 87 percent. Results also indicated that two-stage digestion utilizing shorter detention times would be better for treating high organic wastes than single-stage digestion with a longer detention time. (Galwardi-Texas)
W70-07453

GRAVITY THICKENING TECHNIQUES AT A WATER RECLAMATION PLANT,
Amarillo, Tex.
V. J. Jordon, Jr., and C. H. Scherer.
Journal of the Water Pollution Control Federation, Vol 42, No 2, p 180-189, Feb. 1970. 6 tab, 2 ref.

Descriptors: *Activated sludge, *Sludge treatment, Lagoons, Flocculation, Waste water treatment, Sewage treatment.
Identifiers: *Clarifers, *Thickening, *Blow down, *Bulking, Cationic, Anionic, Polymers.

Various modifications were attempted to control bulking of clarifers in a system handling maximum loads approximately twice the design standards. Blowdown of the final clarifer to an oxidation pond was only a temporary solution as the oxidation pond rapidly began to fill with activated sludge. The use of an empty aerator as a primary effluent holding tank proved to be unsuccessful. The results of the use of an anionic polymer for raw waste water flocculation did not warrant the $5.00/million gal. cost. Flocculation with a cationic polymer of the mixed liquor entering the final clarifers was found to be too expensive at a cost of $8.90/hr of bulking. A 2 million gallon holding tank was constructed as a temporary assistance. Five cationic polymers were used on a plant scale forloadings ranging from 4.5 to 6.97 lb/day/sq. ft. Costs ranged from $1.10 to $3.64/ton of influent suspended solids. A problem of phosphate scale developed in the digester supernatant line system and was alleviated with a hexametaphosphate-lignin compound. (Galwardi-Texas)
W70-07454

THEORY OF SAND FILTRATION,
Bengal Engineering Coll., Howrah (India).
Arun K. Deb.
Journal of the Sanitary Engineering Division Proceedings of American Society of Civil Engineers, Vol 95, No SA3, p 399-422, June 1969. 11 fig, 2 tab, 22 ref.

Descriptors: *Filtration, *Mathematical model, Dimensional analysis, Head loss, Hydraulic gradient.
Identifiers: *Sand filtration, Pore geometry, Filter coefficient, Specific deposit, Filtration time.

The study is an attempt to present a comprehensive filtration theory. A modified mathematical model of filtration of a dilute unisized suspension in water through a homogenous sand filter bed under constant rates of vertically downward flow is presented. The model includes all physical variables involved in filtration to describe the space-time variation of concentration of suspension, specific deposit and hydraulic gradient in the filter medium during a filter run. An expression for dimensionless filter coefficient relating all physical variables of filtration is obtained by dimensional analysis. Solution of the filtration equation is obtained by finite difference method. Computed suspension concentrations at different time intervals and depths of bed agree will with the experimental results. An equation relating head loss per unit depth and specific deposit within the filter bed is derived and the validity of the proposed equation is verified with experimental head loss data. (Shankar-Texas)
W70-07455

ACTIVATED-SLUDGE NITRIFICATION IN THE PRESENCE OF LINEAR AND BRANCHED-CHAIN ALKYL BENZENE SULFONATES,
Wisconsin Univ., Madison.
Charles R. Baillod, and W. C. Boyle.
Applied Microbiology, Vol 16, No 1, p 62-68, Jan. 1968. 6 fig, 2 tab, 18 ref.

Descriptors: *Alkylbenzene sulfonates, *Activated sludge, *Nitrification, Nitrite, Nitrate, Surfactants, Linear alkylate sulfonates, Dissolved oxygen, Detergents.
Identifiers: Branched chain alkyl sulfonates.

Eight batch type, laboratory scale activated sludge units were fed a synthetic substrate of milk solids, nutrients and buffer at intervals of 24 hours. Three units were fed linear alkyl benzene sulfonates (LAS) at concentrations of 6.6, 13.8, and 23.0 mg/l; three units were fed branched-chain alkyl (ABS) benzene sulfonates at concentrations of 6.6, 13.0 mg/l; and two units were used as controls. The units were run with no sludge wasted and dissolved oxygen concentrations between 8 and 9 mg/l. After twenty-nine days of operation almost all of the oxidized nitrogen in the effluent of units fed sulfonates was in the form of nitrate while in the control units only about half of the oxidized nitrogen was in the form of nitrates. Oxidized nitrogen concentrations increased with increasing sulfonate concentrations up to a point and then decreased. In the inhibition range, ABS exhibited proportionately greater effects on the oxidized nitrogen levels than did similar concentrations of LAS. Several hypothesis are suggested to explain the results observed. (DiFilippo-Texas)
W70-07456

AN INVESTIGATION OF SLUDGE DEWATERING RATES,
Massachusetts Univ., Amherst.
John H. Nebiker, Thomas G. Sanders, and Donald Dean Adrain.
Journal of the Water Pollution Control Federation, Vol 41, No 8, Aug. 1969, p R255-R266. 11 fig, 2 tab, 13 ref.

Descriptors: *Design, *Dewatering, *Sludge disposal, Waste water treatment, Digestion, Filtration, Theoretical analysis, Activited sludge, Sludge treatment.
Identifiers: *Dewatering rate, *Drying beds, Pilot-study, Specific resistance, Media factor.

Waste water sludge disposal is one of the most vexing problems of water pollution control. Nearly 25 to 65 percent of total capital and operating costs of primary and secondary treatment plants are expended in handling sludge. It therefore becomes necessary to place more emphasis on volume reductions of the sludge prior to its ultimate disposal. Nearly 72% of treatment plants in the united States utilize sludge drying beds. Past research and gravity dewatering shows very few formulations equating dewatering rates to inherent sludge characteristics. The paper presents theoretical analysis relating depth of sludge and time with the solids-content, specific resistance and coefficient of compressibility. The developed formula is verified experimentally. Further, all parameters are readily determinable by simple laboratory tests, thus presenting an accurate analytical method to predict gravity dewatering and provide a rational basis for selection and optimization of a sludge dewatering system. (Shankar-Texas)
W70-07457

STATE PROGRAMS FOR EXAMINING AND CERTIFYING WASTE WATER TREATMENT PLANT OPERATORS.
Public Administration Service, Chicago, Ill.

Journal of the water Pollution Control Federation, Vol 40, No 1, p 57-75, Jan. 1968. 1 fig, 3 ref.

Descriptors: *Management, *Waste water treatment, Treatment facilities, Education, Legislation, Sewage treatment, Regulation, Permits.
Identifiers: *Operators, *Certification, License.

A study of both mandatory and voluntary certification programs is made. Letters of inquiry were sent to the entire 50 states and replies were received from over 60% of those contacted. The study reveals that the principle stumbling blocks to successful installation of mandatory certification programs are the municipal governments and other employers of waste water treatment operators. They see mandatory certification as a threat to their freedom to employ whom they see fit, and as a method for operators to increase their status and salaries possibly without merit. With some justification, employers do not feel that mandatory certification itself will raise the performance level of the operators. The key is education. Only education can raise the performance level of the operators. Certification can then become a method for assuring that a certain minimum level of education has taken place. Mandatory certification can lead to reduced pollution, protection of capital investments for employers, increased pride, status, and salary of operators, and an overall better living condition for the public. Voluntary programs are a good and perhaps necessary first step. Program problems, benefits, position of interest groups and operator training are discussed. (Hancuff-Texas)
W70-07458

CATION-DEPENDENT FLOCCULATION IN A FLAVOBACTERIUM SPECIES PREDOMINANT IN ACTIVATED SLUDGE,
Tokyo Metropolitan Univ. (Japan).
Yasuhiko Tezuka.
Applied Microbiology, Vol 17, No. 2, p 222-226, February, 1969. 1 fig, 2 tab, 14 ref.

Descriptors: *Flocculation, *Activated sludge, Calcium, Magnesium, Ions, Metabolism, *Activated sludge.
Identifiers: *Flavobacterium, Cations, Taxonomical.

Of the isolates botained from plating of activated sludge, 60% appeared to belong to the genus Flavobacterium. The taxomomical properties, flocculation process, and metabolic activity of these isolates were studied. The isolates were all small rods without flagella. All the isolates required amino acids and vitamins as nutrients. To determine what kind of mineral components affect flocculation, the bacterium was grown in media containing either CaCl2, MgCl2, or both CaCl2 and MgCl2. Results showed that both calcium and magnesium ions were indispensable to floc formation, although the role of the calcium is more important than that of the magnesium ion. No other mineral salts could produce flocculation. Suspending flocs indeionized water and shaking caused disintegration of flocs. Addition of mineral salts resulted in the cells flocculating again. This reflocculation was observed with both live and dead cells suggesting that flocculation is physiochemical rather than physiological process. Since the electric charge of the cells surface was negative a possible mechanism for floc formation is that negative cell surfaces are bridged by ionic bonds intermediated by cations. (DiFilippo-Texas)
W70-07459

VALUE OF INSTRUMENTATION IN WASTE WATER TREATMENT,
Albright and Friel, Inc., Philadelphia, Pa.
Joseph J. Salvatorelli.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 101-111, Jan. 1968. 11 fig, 1 tab.

Descriptors: *Instrumentation, *Control system, *Waste water treatment, Flow, Industrial wastes, Sewage treatment, Monitoring, Operation and maintenance, Sewers.
Identifiers: *Centralized control, Meters.

Instrumentation is described as a valuable tool which if used properly by the operator will free him to perform duties which require human attention. Mechanical, physical, and chemical methods may be used to control various processes within a system. Instrumentation for specific values are described, e.g. flow measurements, liquid levels, in wet wells, operating pressure records, continuous recording, pH, temperature, and density analyzers. Specific applications are given for industrial waste treatment as well as domestic waste water. The example for the industrial waste treatment is that of a metal waste which contains heavy concentrations of cyanide, chromium and other heavy metals. Each treatment phase depends on maintaining optimum pH to assure use of the minimum amount of chemicals needed to carry out the reaction. The burdensome job of maintaining optimum pH at the beginning of each of the treatment cycles was accomplished entirely by pH instrumentation and direct control of chemical application. The second illustration of a system is designed primarily for monitoring an entire waste water disposal system including pumping stations, overflow diversion chambers, and the treatment plant. Because of the magnitude of the system, instrumentation and control at the waste water treatment plant has been limited to only those functions which were necessary for proper plant operation. Costs are usually less than 5% of the total project costs. (Hancuff-Texas)
W70-07460

ANALYSIS OF MUNICIPAL AND CHEMICAL WASTE WATERS BY AN INSTRUMENTAL METHOD,
Dow Chemical Co., Midland, Mich. Analytical Science Lab.
For primary bibliographic entry see Field 05A.
W70-07461

METABOLISM OF SOME ANIONIC TALLOW-BASED DETERGENTS BY SEWAGE MICROORGANISMS,
Eastern Regional Research Laboratory, Wyndmoor, Pa.
Theone C. Cordon, Elmer W. Maurer, M. V. Nunez-Ponzoa, and A. J. Stirton.
Applied Microbiology, Vol 16, No 1, p 48-52, January 1968. 4 fig, 1 tab, 5 ref.

Descriptors: *Detergents, *Metabolism, Chemical oxygen demand, Linear alkylate sulfonates, Activated sludge, Sewage treatment.
Identifiers: Methylene blue activity, Anionic.

Detergents in the amount of 40 mg/l were added to water containing nutrients and 10 mg/l of activated sludge. The contents were continuously stirred. Eleven types of detergents were used, including: tallow alchol sulfates, long-chain ether alcohol sulfates and x-sulfo fatty acids. Linear alkyl sulfonate (LAS) was used as a reference material. Samples were withdrawn daily. Chemical oxygen demand (COD) was measured on centrifuged samples. A methylene blue activity procedure (MBAS) was used to determine the detergent concentration of settled samples. Detergent is no longer registered in the MBAS test when the carbon chains are shortened to about six to eight carbon atoms. With reference to COD, alcohol sulfates were the most rapidly and completely metabolized (96 to 99 percent) and one ether alcohol sulfate was 94% degraded. LAS was 80% degraded and all other detergents fell in the range of 61 to 87% degraded. Except for alcohol sulfates, loss of methylene blue activity occurred long before COD values reached a minimum. With the alcohol sulfates, COD and MBAS decreased simultaneously. (DiFilippo-Texas)
W70-07463

PERSONNEL TRAINING UTILIZATION AND POLICY,
Philadelphia Water Dept., Pa.; West Virginia State Dept. of Health; Metropolitan Sanitary District of Greater Chicago, Ill.; Federal Water Pollution Control Administration, Washington, D.C.; and Water Pollution Control Ames, Iowa.
Samuel S. Baxter, Glen O. Fortney, Donald R. Morrison, Vinton W. Bacon, and John M. Rademacher.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 1-15, Jan. 1968. 2 ref.

Descriptors: *Management, *Training, Personnel, Education, Performance, Sewage treatment, Permits.
Identifiers: *Operators, *Certification, Policy, Unions.

Utilization of personnel in municipal waste water treatment and collection systems is effected by the lack of a profit motive. Management is charged however, with proper personnel training and utilization. Mandatory certification programs have succeeded in bringing about improved training and consequently, have had a net effect of improved operation, better salaries, better working conditions, and better employer-employee relationships. Efforts to organize public employees are increasing and public officials must prepare for it and face the question of defining management, negotiation, recognition, agreements, strikes, and union shops. Personnel in the field can expect greater and closer attention to the performance of their plants by state and federal authorities. Federal programs are being arranged to furnish training, and technical advisory assistance to treatment personnel. The federation, through its operator training courses and its promotion of certification is attempting to assist in improving the capability and the status of the waste water treatment plant operators. (Hancuff-Texas)
W70-07464

CITRIC ACID FROM CITRUS PROCESSING WASTES,
Florida Univ., Lake Alfred.
Sterling K. Long.
Proceedings of the Industrial Waste Conference, 23rd, p 18-25, 1968. 4 tab, 6 ref.

Descriptors: *Industrial wastes, *Fermentation, Citrus fruits, Feeds, Cation adsorption, Waste water treatment.
Identifiers: *Citric acid, *Citrus wastes, Press liquors, Molasses.

Wastes generated in the citrus industry include press liquors and plant waste water. Present practice involves evaporation of press liquor to citrus molasses which is used as a feed. Plant waste water is disposed in a variety of ways. Fermenting the carbohydrates in the waste to produce citric acid is a new approach to disposal. A mixture of 600-700 gallons of waste water and 175 gallons of molasses results in a solution of optimal total sugar content for fermentation (15-17 percent). With citric acid yields of 50-70 percent of theoretical, the gross value of acid produced is $135 - $189 per ton of molasses processed as compared to a sale value for molasses of $14-$16 per ton. Investigation showed a mixture of molasses and tap water to be suitable substrate for fermentation by A. niger. Required or desired treatment included: adsorption with cationic resins and addition of 0.3 percent ferrocyanide to remove iron. Optimum conditions included a temperature of 28-30 deg C and vigorous shaking during the first 24 hours followed by oxygen sparging during the next 24-48 hours. Yields of 25 percent of theoretical have been observed. (DiFilippo-Texas)
W70-07467

REMOVAL OF NITROGEN AND PHOSPHORUS,
Stanford Univ., Calif. Dept. of Civil Engineering.
Rolf Eliassen, and George Tchobanoglous.
Proceedings of the Industrial Waste Conference, 23rd, p 35-48, 1968. 5 tab, 16 ref.

Descriptors: *Cost comparisons, *Efficiencies, *Nitrogen, *Phosphorus, Algae, Biological treatment, Waste water treatment.
Identifiers: *Removal processes, Chemical treatment, Overfertilization, Physical treatment, Unit operations, Unit processes.

The need to remove nitrogen and phosphorus from waste waters stems from the fact that they are capable of stimulating and promoting the undesirable growth of algae and aquatic plants. The important forms of nitrogen are ammonia, nitrite and nitrate, while phosphorus may occur as soluble inorganic phosphates. Nitrogen and phosphorus removal methods may be classified as biological, chemical and physical. Biological methods include activated sludge, trickling filters and anaerobic treatment. Chemical and physical processes include ion exchange, electrodialysis, reverse osmosis and distillation. Typical removal efficiencies range between 40 to 98 percent and 30 to 98 percent for nitrogen and phosphorus compounds, respectively. In planning and designing facilities to be used for the removal of nitrogen and phosphorus, key factors which must be considered are: (1) whether compounds of one or both are to be removed, (2) the use to be made of the treated waste water, (3) the available means for disposing of the ultimate contaminants, and (4) the economic feasibility of the selected process or processes. The estimated removal costs per million gallons range from $4 to $1000 for both nitrogen and phosphorus depending on the process used and degree of treatment required. (Aguirre-Texas)
W70-07469

A SURVEY OF INDUSTRIAL WASTE TREATMENT COSTS AND CHARGES,
Stone (Ralph) and Co., Inc., Los Angeles, Calif.
Ralph Stone, and Curtis Schmidt.
Proceedings of the Industrial Waste Conference, 23rd, p 49-62, 1968. 2 fig, 6 tab, 2 ref.

Descriptors: *Costs, *Industrial wastes, *Surveys, *Treatment, *Cost allocation, Volume, Biochemical oxygen demand.
Identifiers: *Sewers, *Charges, Suspended solids.

A preliminary analysis was presented of the extent to which the cities of America have met the challenge of providing industrial waste disposal on an equitable cost basis. Estimates were projected for waste quantities generated, sewer use, and capital outlays associated with industrial waste. Approximately one-third of the cities provided for separate industrial waste charges with the majority of these using volume as the only criterion. It was reported that the average annual cost of sewage services to a citizen living in a community of under 100,000 population was approximately $20 and the average annual per capita cost in large communities was $14. The results of the questionnaire were analyzed to determine the effect of four typical sewer charge methods on the allocation of costs to industrial firms generating varying volumes of waste water and BOD. It was suggested that probably the most equitable arrangement was that in which a part of the revenues were obtained by charges based on BOD, suspended solids, and volume of wastes discharge to the sewer and another portion by property taxes on all properties. The cooperation of local industry and civic promotional groups should be solicited in drawing up an industrial sewer service charge program. (Galwardi-Texas)
W70-07470

RECOVERY OF ZINC FROM VISCOSE RAYON EFFLUENT,
Courtalds (Canada) Ltd., Cornwall (Ontario).
R. S. Aston.
Proceedings of the Industrial Waste Conference, 23rd, p 63-74, 1968. 8 fig, 3 tab, 4 ref.

Descriptors: *Ion exchange, Pilot plant, Corrosion, Economics, Waste water treatment, Industrial wastes, Textiles.
Identifiers: *Zinc, *Viscose rayon effluent, *Poisoning, Life, Regeneration-cycle, Temperature effects, Interfering ions.

Experimental methods have been adopted to remove zinc from acidic waste produced from a viscose rayon plant. The technical and economic feasibility of ion exchange for zinc recovery was explored, by a bench scale pilot plant. The main purpose was to examine the life of the resin and determine the poisoning which could be expected from low concentration organic surfactants present in the effluent stream. A 20-inch resin column of 3/4 inch diameter was used preceeded by two quartz filters to remove suspended matter. The ion exchange process is described. It is estimated that this method ensures the recovery of zinc to about 92 percent. Some organic matters and amines were found to affect the efficiency of resin to some extent. Washing the resin bed with 4 percent caustic soda solution would reduce the poisoning due to mineral oil. The resin life id dependent upon the number of cycles it is operated per day. Experimental data indicate that the life of the resin is approximately four years. This process is more effective than the evaporation method. (Shankar-Texas)
W70-07471

ANAEROBIC-AEROBIC TREATMENT OF SPENT VEGETABLE TAN LIQUORS FROM A SOLE LEATHER TANNERY,
Cincinnati Univ., Ohio.
J. David Eye, and John G. Aldous.
Proceedings of the Industrial Waste Conference, 23rd, p 126-139, 1968. 11 fig, 3 tab, 8 ref.

Descriptors: *Pilot plants, Aerobic treatment, Biological treatment, Waste water treatment, Industrial wastes.
Identifiers: *Anaerobic-aerobic lagoon, *Spent tan liquors, *Tannery wastes, Anaerobic treatment, Tannin industry.

Because of the relatively unfavorable economic position of the sole leather industry the basic criteria for a satisfactory waste treatment system include: a low capital investment; low operating costs; simplified operating procedures; flexibility in operation; small land usage; and performance capability commensurate with effluent requirements. Studies on the volumes and characteristics of the wastes from tanneries show that about 75 to 85 percent of the major pollutants are contained in only 20 to 30 percent of the total waste volume. The volume of waste water discharged from the tannery under study varied from 450 to 590 gal/hide. The two waste streams of greatest concern are the lime-sulfide liquors and the spent tan solutions, both derived from batch type processes. A detailed study of the anaerobic-aerobic procedure for treating spent vegetable tan liquors was performed in a pilot scale stratified lagoon. The anaerobic unit was loaded at approximately 960 lbs COD/1000 cu. ft./day. The overall removal efficiency of the pilot unit in treating spent tan liquors averaged about 85 percent for all parameters measured. For a total flow of 0.5 MGD and a detention period of nine days it was estimated that the capital costs and operating costs would be $50,000 and $12,000, respectively. (Aguirre-Texas)
W70-07472

A REVIEW OF CITRUS WASTES AND THEIR PROBLEMS,
Orange County Water Conservation Dept., Orlando, Fla.
C. W. Sheffield, R. R. McNary, and L. D. Killingsworth.
Proceedings of the Industrial Waste Conference, 23rd, p 140-153, 1968. 7 fig, 6 tab, 16 ref.

Descriptors: *Citrus fruits, *Waste treatment, Industrial wastes, Biochemical oxygen demand, Color, Activated sludge, Trickling filter, Lagoons.
Identifiers: Solids, Unit processes, Spray, Irrigation.

Citrus wastes from various processes are characterized and treatment for each waste discussed. Fresh fruit packaging wastes come from three sources: washing, preserving and coloring. Washing operations waste contains solids and detergents and is fine-screened. Coloring operation wastes are high in BOD and color and may be hauled to a disposal plant. Preserving operation wastes are diluted, settled and released to a drainfield. Single strength juice processing produces waste from juicing operations and clean-up waters. Juicing operation wastes, which are high in solids, are usually dried and the residue processed into cattle feed. Clean-up waters should be fine-screened and treated biologically. Sectionizing wastes are similar to those described in juicing operations. Juice concentrating wastes consist of spillage and barometric condenser water. Spillage is often processed into feed. Barometric condenser water is high in volume but low in BOD. The various unit processes applicable to citrus wastes are discussed. These processes include: lagooning, hauling, dilution, trickling filter, activated sludge, and spray irrigation. (DiFilippo-Texas)
W70-07473

THE OCCURRENCE OF FUNGI IN ACTIVATED SLUDGE,
Federal Water Pollution Control Administration, Washington, D.C.
William Bridge Cooke, and Wesley O. Pipes.
Proceedings of the Industrial Wastes Conference, 23rd, p 170-182, 1968. 5 tab, 23 ref.

Descriptors: *Activated sludge, *Fungi, Yeasts, Microbiology, Waste water treatment, Sewage treatment.
Identifiers: Colony isolation, Pour plating, Streaking, Geotrichum candidum, Trichosporon, Penicillum.

Samples of the waste, sludge and the effluent were obtained from eighteen activated sludge sewage treatment plants. Three successive tenfold dilutions were made and both streaked and pour plated on GPY agar and ND agar which are recommended for fungi. The first 35 sets of samples contained 20 fungi species or species groups. Of these, three were widely distributed: Geotrichum candidum, Trichosporon spp, and Penicillum spp. Four occured in only one set of samples each, while the other 13 species were found in two to 21 sets of samples. Only 1.18 per cent of the colonies represented yeast species. While G. candidum and Trichosporon spp were present in relatively large numbers throughout the year, other generic groups tend to be less abundant, or even absent, during the winter. Data indicate that fungi are among the active organisms in biological treatment of sewage and the population of fungi observed include species which are able to use a wide variety of substrates. (DiFilippo-Texas)
W70-07474

FIELD EVALUATION OF AERATORS IN ACTIVATED SLUDGE SYSTEMS,
Illinois Univ., Urbana.
John T. Pfeffer, Fred C. Hart, and Lawrence A. Schmid.
Proceedings of the Industrial Wastes Conference, 23rd, p 183-194, 1968. 2 fig, 8 tab, 8 ref.

Descriptors: *Aeration, *Activated sludge, Oxygen requirements, Temperature, Dissolved oxygen, Waste water treatment, Sewage treatment.
Identifiers: Contact stabilization, Alpha coefficient, Oxygen transfer rate.

Fundamental theory of oxygen transfer are developed mathematically. The oxygen transfer rate (mg/l/hr) is a function of : KLa, oxygen transfer coefficient; alpha-g, the ratio of KLa of mixed liquor to KLa at standard conditions; Cs, oxygen saturation concentration; B, ratio of Cs in mixed liquor to Cs at standard conditions; Co, oxygen concentration present; temperature; and oxygen demand rate. Equations are given to express the oxygen transfer rate as well as KLa for diffused air aeration and turbine aeration. Values of alpha, B and Oxygen demand were determined at the Topeka, Kansas contact stabilization activated sludge plant. February alpha values ranged from

0.404 to 0.576 and 0.540 to 0.720 while August values ranged from 0.335 to 0.440 and 0.540 to 0.605 for the contact tank and reaeration tank respectively. All values of B ranged from 0.97 to 1.00. Oxygen uptake rates are given for both 15 and 10 horsepower aerators in the contact tank and reaeration tanks in February and August. The ranges determined include: 48.0 to 69.3 mg/l/hr (contact tank, 15 hp, August) and 103.7 to 149.0 (Reaeration tank, 15 hp, August). (DiFilippo-Texas)
W70-07475

SHORT TERM BOD USING THE AUTOMATIC RESPIROMETER,
Rose Polytechnic Inst., Terre Haute, Ind.
R. M. Arthur, and W. N. Hursta.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 242-250. 11 fig, 4 ref.

Descriptors: *Biochemical Oxygen Demand, Sewage, Least squares method, Instrumentation, Water.
Identifiers: *Oxygen uptake, *Automatic Respirometer.

Short term oxygen uptake rates using an automatic respirometer and five-day BOD values were determined on duplicate samples of settled sewage. The amount of oxygen uptake after four and seven hour periods was plotted against the five-day BOD value and lines of best fit determined. The average deviation of five-day BOD from these lines was 21.3 percent utilizing four hour uptake and 15.8 percent utilizing seven hour uptake. These deviations are comparable to the reported accuracy of plus or minus 20 percent for the five-day BOD test. The oxygen uptake curves obtained were investigated and an equation of the form $Y = a + bx + c\ (x\ sq)$ was found to best relate oxygen uptake to time. Attempts to correlate the coefficients c or b for a particular sample with the five-day BOD resulted in average deviations of five-day BOD from the line of best fit of 23.8 percent for the coefficient c and 22.0 percent for the coefficient b. (DiFilippo-Texas)
W70-07476

HIGH-RATE DIGESTION CONTROL III-ACID BASE EQUILIBRIUM AND BUFFER CAPACITY,
Georgia Inst. of Tech., Atlanta.
F. G. Pohland.
Proceedings of the Industrial Wastes Conference, 23rd, 1968, p 275-284. 3 fig, 2 tab, 6 ref.

Descriptors: *Equilibrium, *Anaerobic digestion, Acids, Hydrogen ion concentration, Waste water treatment.
Identifiers: *Buffer capacity, Bases, Disassociation.

Many of the products of anaerobic digestion are weak acids or weak bases. It is convenient to characterize the aqueous environment on the basis of acid-base equilibrium using pH as the master variable. Equilibrium expressions are developed which permit quantitative evaluation of primary acid-base equilibria contributing to the pH response within the anaerobic environment; these results are confirmed by experimental results; the results are used to describe the relative condition of the process and the concept of buffer capacity is introduced. Analysis of the equilibria involved indicates that the buffer system of importance to pH control during anaerobic digestion can be represented by the respective disassociations of the monoprotic species, ammonia and acetic acid and the first disassociation steps of the diprotic species, hydrogen sulfide and carbonic acid. Values of pH predicted from equilibria considerations corresponded well with pH observed during the anaerobic digestion of synthetic garbage. Buffer capacity, the inverse slope of the acid-base titration curve, at a certain pH in relation to the rate of evolution, neutralization or removal of acidic or basic products, may be used to predict the probability of change of digestion conditions. (DiFilippo-Texas)
W70-07477

THREE YEARS OPERATION OF AERATED STABILIZATION BASINS FOR PAPERBOARD MILL EFFLUENT,
Packaging Corp. of America, Rittman, Ohio.
Franklyn D. Haynes.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 361-373. 6 fig, 6 tabs.

Descriptors: *Aerobic treatment, *Waste water treatment, Nutrients, Temperature, Biochemical Oxygen Demand, Dissolved oxygen, Cost, Sludge, Chemical Oxygen Demand, Pulp and paper industry, Pulp wastes.
Identifiers: *Aerated lagoons, *Secondary waste treatment, *Waste stabilization, Primary waste treatment, Suspended solids (SS).

Because of problems caused by overloading, the waste stabilization ponds of Packaging Corporation of America were converted to aerated stabilization basins. The treatment now consists of screening and primary settling, aerated lagoons followed by settling lagoons and post aeration before discharge. Ninety percent of the SS and 25 percent of the BOD were removed in primary treatment. With an eleven day detention time, the BOD was reduced from 468 mg/l to 69 mg/l and suspended solids were reduced from 3.2 lb/mg to 2.0 lb/MG in the aeration basins on the average. The settling lagoons further reduced the BOD and SS to 63 mg/l and 1.1 lb/MG respectively. The final discharge, following post aeration, contained an average of 56 mg/l BOD, 3.8 mg/l DO and 1.9 lb/MG suspended solids. During the three years of operation, BOD reduction ranged 69 to 95 percent. Although sampling showed little variation of COD, DO, or SS within an aeration basin, an estimated 720 tons of sludge accumulated in the aeration basins during 1967. The effect of temperature variation and nutrient addition is also discussed. The cost of operation including nutrients and labor but excluding taxes and amortization was 6.4 cent/MG in 1967. (Bishop-Texas)
W70-07478

PRELIMINARY RESULTS OF A NEW APPROACH IN THE AEROBIC BIOLOGICAL TREATMENT OF HIGH CONCENTRATED WASTES,
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fred M. Welch.
Proceedings of the Industrial Wastes Conference, 23rd, 1968, p 428-437. 8 fig, 2 ref.

Descriptors: *Sewage treatment, *Biomass, Dissolved oxygen, Temperature, Chemical Oxygen Demand, Aerobic treatment, Waste water treatment.
Identifiers: *Rotating biological contactor, *Discs, Revolution speed, Hydraulic loadings.

The Rotating Biological Contactor (RBC) consists of a series of rotating discs which are partially submerged in waste water and, as the discs are rotated, carry a thin film of fluid into contact with air. On these discs a biological film is established and thus the discs act as an aeration mechanism and a mechanism to contact biomass with waste water. A synthetic sewage consisting of dairy solids and nutrients was treated in a two stage RBC system. Various amounts of concentrated synthetic sewage were mixed with tap water to give influent COD values of 500 to 4000 mg/l. Other variables investigated included: hydraulic loading, dissolved oxygen content of the mixed liquor, temperature, solids content of the mixed liquor and disc rpm. BOD reductions of the synthetic waste correlated well with previous results from settled sewage. Increased disc rpm favorably affected the process and this could be due to either increased agitation or increased dissolved oxygen of the mixed liquor. It is concluded that the RBC has a great many operating parameters that allow process variation which makes the RBC suitable for treating a wide range of biodegradable wastes. (DiFilippo-Texas)
W70-07479

DEWATERING PAPER MILL SLUDGE BY VACUUM FILTRATION,
West Virginia Pulp and Paper Co., Covington, Va.
Alan M. Lindsey.
Proceeding of the Industrial Waste Conference, 23rd, 1968, p 438-446. 6 fig, 2 tab.

Descriptors: *Filtration, *Dewatering, *Sludge, Disposal, Design, Filter, Waste treatment costs, Pulp wastes, Sludge treatment.
Identifiers: *Paper mill sludge, Pilot data, Lagooning, Thickener, Trucking.

The problems encountered in the lagoon method of disposal of solids in the Covington Mill since 1955 are discussed. The major problem was the lagoon overflow which created a BOD load on the plant of up to 30,000 lbs/day and a hydraulic load of 2 mgd. It was estimated that the lagoon would be full in three years. Extensive dewatering studies were therefore conducted to evaluate filters, centrifuges and screw presses. The operation and performance characteristics of filters are discussed. Attempts were made to correct various factors such as filter feed solids and cake solids, filter feed solids and filter loading, and cycle time and filter load, but the correlation was poor due to the variability of sludge characteristics. The solid disposal system utilizing vacuum and trucking to a land fill has been in operation at Covington for nearly two years. This system has worked well on all types of sludge that have been encountered, except pulp tailings. Methods for further dewatering and incineration in power boilers have been investigated, but a workable system has not been completely developed. (Shankar-Texas)
W70-07480

LONG TERM AERATION OF KRAFT PULP AND PAPER MILL WASTES,
Riegel Paper Corp., Riegelwood, N.C., Pulp and Paperboard Div.
Marshall T. White.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 447-457. 3 fig, 3 tab.

Descriptors: *Design, *Efficiencies, *Pulp and Paper industry, Biochemical Oxygen Demand, Costs, Industrial wastes, Nutrient requirements, Pilot plants, Pulp wastes, Waste water treatment.
Identifiers: *Aerated lagoons, *Surface aerators, BOD removal, Extended aeration, Oxygen transfer, Secondary treatment, Stream standards.

The Riegelwood paper mill originally produced 200 tons/day of bleached kraft pulp. The original waste treatment facilities consisted of a 230 acre retention basin that permitted storage or the 14 MGD of waste for 39 days. The basin provided satisfactory treatment for only a short time, as the production rate of the mill has increased continuously since its initiation. Stream standards for the Cape Fear River require a minimum DO of 3.0 mg/l. A pilot plant was installed to evaluate the treatability of the mill wastes with supplemental surface aeration. Biochemical oxygen demand (BOD) removals of 84 percent were possible with the pilot plant and laboratory determinations indicated that the waste had an alpha value of 0.7, which was used in designing the treatment system. Fourteen-60 HP aerators were installed and achieved an 88 percent BOD removal efficiency during the summer-fall period. The aerators are not operated during the winter months, when river oxygen resources are sufficient to assimilate the total waste load without treatment. The total cost of the surface aeration system was $260,000 and the annual operating costs are about $56,000. The total cost of all equipment installed to date for monitoring and treating the mill waste is a little over one and a quarter million dollars. Since the installation of the aerator system, there has been a gradual increase in mill production which has increased the volume of waste to about 40 MGD. Fifteen-20 HP aerators were installed to extend the aeration time. Through the use of additional aerators, the basin is expected to provide adequate treatment for a waste volume up to 100 MGD. (Aguirre-Texas)
W70-07481

STABILIZATION OF A LOW SOLIDS CARBOHYDRATE WASTE BY AN ANAEROBIC SUBMERGED FILTER,
Texas Univ., Austin.
Alan H. Plummer, Jr., Joseph F. Malina, Jr., and W. Wesley Eckenfelder, Jr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 462-473. 6 fig, 3 tab, 6 ref.

Descriptors: *Anaerobic bacteria, *Anaerobic digestion, *Waste treatment, Biochemical Oxygen Demand, Chemical Oxygen Demand, Methane, Methane bacteria, Acids, Industrial wastes, Waste water treatment, Carbohydrates.
Identifiers: *Solids retention time, *Anaerobic filter, Detention time.

Four laboratory scale submerged anaerobic filters were operated at various hydraulic loadings. The units were filled with a mixture of Raschig rings and berl saddles giving the filter media a porosity of 65 to 70 percent. Hydraulic detention times of 83, 60, 21 and 13 hours in the units gave organic loadings of 101, 237, 438, and 638 pounds COD per cubic foot per day. Effluent and influent BOD and COD, PH, volume of gas produced, composition of gas produced, alkalinity, volatile acids and solids were monitored. The raw feed had a BOD of 5,200 mg/l and COD of 8475 mg/l. Steady state COD removal efficiencies ranged from 86 percent to 30 percent for the four units while BOD removal efficiencies of 94 percent to 41 percent were observed. Higher loadings gave rise to higher effluent solids, thereby reducing solids retention time to a point insufficient for establishment of a satisfactory microbial environment. Solids retention times ranged from 163 days to 4 days and effluent solids ranged from 455 mg/l to 1855 mg/l. The effluent solids were readily separated by gravity settling. (DiFilippo-Texas)
W70-07482

TERTIARY TREATMENT OF SECONDARY INDUSTRIAL EFFLUENTS BY ACTIVATED CARBON,
Texas Univ., Austin.
Ned K. Burleson, W. Wesley Eckenfelder, Jr., and Joseph F. Malina, Jr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 474-483. 6 fig, 3 tab, 8 ref.

Descriptors: *Activated carbon, *Tertiary treatment, *Industrial wastes, Chemical Oxygen Demand, Adsorption, Activated sludge Waste treatment.
Identifiers: *Langmuir isotherm, Total organic carbon, Refinery waste, Petro chemical waste, Refractory materials.

Effluents from laboratory and plant scale activated sludge reactors were filtered through Whatman Number 42 filter paper. The effluents were from treatment of two refinery and one petrochemical wastes and had COD values and TOC values respectively of 86 and 23 mg/l, 40 and 16 mg/l; and 107 and 33 mg/l, for refinery waste number one. Refinery waste number 2 and the petrochemical waste respectively. Various amounts of activated carbon from the same source but of two different mesh sizes were added to the wastes and agitated for contact times up to 320 hours. While the smaller mesh size exhibited a higher rate of adsorption in the early stages of the tests the removal after 320 hours of contact time was essentially the same. Data indicate that: the bulk of adsorption took place in the first 100 hours of contact time; that activated carbon will remove up to 85% of refractory material expressed as TOC from secondary industrial effluents; and the Freundlich isotherm successfully described the adsorption process in the batch studies. Activated carbon columns were used to treat waste containing 2, 4 dichlorophenol and concentration time profiles from each column recorded. (DiFilippo-Texas)
W70-07483

NEW SECONDARY AERATED STABILIZATION BASINS AT THE MORAINE DIVISION,
Kimberly-Clark Corporation, West Carrollton, Ohio. Moraine Mill.
William M. Laing.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 484-492. 3 tab.

Descriptors: *Pulp and paper industry, Costs, Efficiencies, Industrial wastes, Nutrient requirements, Sludge disposal, Treatment facilities, Waste water treatment, Pulp wastes.
Identifiers: *Aerated stabilization lagoons, BOD removal, DO levels, Primary treatment, Secondary treatment, Surface aerators.

Operating experiences encounted with the aerated stabilization basins treating 5.5 MGD of waste water from the Moraine Mill of the Kimberly-Clark Corporation in West Carrollton, Ohio are described. Production amounts to 280 tons/day of business paper and 125 tons/day of secondary fiber. The normal mill waste effluent is high in mineral content, suspended solids of 200 mg/l and BOD of about 750 mg/l. The treatment facilities include an elaborate primary clarification scheme with sludge dewatering and disposal. Biochemical oxygen demand (BOD) reduction is very high, averaging between 45 and 50 percent. Secondary treatment of the clarified effluent is done in two aerated stabilization basins that provide a 6 day retention time and a minimum of 85 percent BOD removal. In each lagoon are three floating aerators, powered by 60 hp motors. Nutrient is fed to the clarified water between the clarifiers and the basins in the form of phosphoric acid and anhydrous ammonia. Current expansion of the mill will increase production capacity by 50 percent; the addition of a third aerated basin with three additional 75 hp aerators will permit the continued overall BOD reduction of 85 percent or better. (Aguirre-Texas)
W70-07484

RECOVERY AND REUSE OF OIL EXTRACTED FROM INDUSTRIAL WASTE WATER,
Ford Motor Co., Cleveland, Ohio.
Gordon J. Schutt, Charles C. Keil, and Steve J. Holasz.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 493-496. 2 fig.

Descriptors: *Oil wastes, *Oily water, *Waste water treatment, *Cost benefit analysis, *Costs, Water reuse, Industrial wastes.
Identifiers: *Waste oil reclamation.

Two industrial waste treatment plants are maintained to treat the process wastes of the two Cleveland Engine Plants of the Ford Motor Company. The output of these treatment plants consists of clarified water, sludge slurry, and skim oil. The skim oil contained 70% water, and the major cost of disposal was hauling it away. Experimentation with a commercial de-emulsifying agent resulted in complete separation of the emulsified oil and water mixture. The oil recovered was of such good quality that it was reused as a soluble emulsified cutting oil in the Engine Plants. Costs of cutting oil could be reduced from $0.90/gal to $0.16/gal by reuse of the skim oil. Reclaimed oil base coolants last 40-50% longer than virgin oil base coolants. Corrosion inhibition is better also. Machinery stays cleaner with reclaimed oil. New facilities being built will supply the full soluble oil base demand for both Engine Plants. In the new facilities solids will be removed by filtration, rather than gravity settling as was the case in the pilot plant study. (Makela-Texas)
W70-07485

TECHNICAL AND LEGAL CONTROLS FOR THE DISPOSAL OF ANIMAL WASTES,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
Raymond C. Loehr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 507-519. 2 fig, 5 tab, 21 ref.

Descriptors: *Animal wastes, *Runoff, *Management, *Farm management, *Aerobic treatment, *Water pollution, *Water pollution control, *Water pollution treatment, *Solid wastes, *Legal aspects, Runoff forecasting, Cattle, Hogs, Poultry, Farm wastes.
Identifiers: *Manure, *Agricultural runoff, Anaerobic lagoons.

Several alternatives exist for disposal of animal wastes: (1) land disposal of liquids and solids, (2) solids combustion with land disposal of liquid, and (3) discharge of solids and liquids to receiving waters. All these alternatives are potential sources of water pollution. The quality of treated and untreated animal waste waters, both from a legal point of view and a farmers point of view, are discussed. Animal wastes are normally semi-solid, thus high in BOD, COD, suspended solids, Na, NH3. If rainfall runoff is allowed to mix with the animal wastes, a larger volume of waste will need to be treated. Many states now consider large livestock operations to be industrial processes and require treatment of wastes in such a manner that receiving waters are not harmed by discharge of animal waste waters. Waste water runoff holding ponds are commonly used with intermittent discharge to receiving waters or land disposal. Several processes are used for treatment of animal wastes, the more common being anaerobic lagoons, aerobic lagoons, aerated lagoons, oxidation ditches, or a combination of anaerobic-aerobic treatment. In more arid areas, runoff holding ponds are sometimes satisfactory. Handling and treating animal wastes as a liquid usually involves less labor, less expense, and thus is more commonly found in large livestock operations where concrete pens are found and confinement is practiced. Since liquid wastes require more treatment, handling the animal wastes directly as a semi-solid with land disposal might be a more economic method. (Makela-Texas)
W70-07486

BIOLOGICAL TREATMENT OF A DISTILLERY WASTE,
Kentucky Univ., Lexington.
Carl E. Burkhead, Claude A. Lessigh, and Tad R. Richardson.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 520-527, 3 fig, 4 tab, 12 ref.

Descriptors: *Activated sludge, *Waste water treatment, *Biochemical Oxygen Demand, *Industrial wastes, *Design criteria, Aeration, Lagoon, Design.
Identifiers: *Aerated lagoon, *Extended aeration, Distillery wastes, (Bardstown, Kentucky).

This investigation showed that distillery wastes could be treated using an aerated lagoon system. Sources, volumes, and characteristics of the distillery waste were presented. Results from an extended aeration pilot plant showed BOD removals varied from 77-97 percent with an average removal of 91.5 percent. Corresponding BOD loadings were from 3-27 lbs/day/1000 cuft with an average loading of 18. An aerated lagoon system based on a design flow of 150,000 gpd and a BOD of 550 mg/l was selected. The maximum allowable operating temperature was set at 110 F. A polishing pond was included in the design so as to improve winter operation. Oxygen transfer and mixing requirements for the aerated lagoon system were provided by mechanical aerators. A total construction cost of $71,000 was estimated. (Galwardi-Texas)
W70-07487

POULTRY PROCESSING WASTES TREATMENT EXPERIENCE IN AERATED PONDS,
Griffith (Llewellyn B.), Falls Church, Va.
C. C. Griffith.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 537-539, 1 fig, 1 ref.

Descriptors: *Poultry, *Waste treatment, *Waste water disposal, *Aeration, *Costs, *Cost sharing, Cost allocation, Cost analysis, Circulation, Lagoons, Industrial wastes, Waste water treatment.

Identifiers: Aerated ponds, Aerobic treatment, Aerated lagoons, Parshall Plume, Circulators.

The poultry waste emanating from the Sterling Processing Corporation of Oakland, Maryland, is treated in two aerated ponds in series. Production is seasonal, being double in the fall. Daily production in the fall is approximately 200,000 lbs live weight per day with a BOD loading of 1600 lbs per day average maximum and 1900 lbs per day peak maximum. Aeration is supplied by positive displacement blowers discharging through fixed circulators in the two ponds. Waste water circulates at 1 fps and has an average retention time of 14 hours. Biochemical oxygen demand (BOD) in the first pond is reduced from an influent concentration of 800-1000 mg/l to 70-100 mg/l, and to less than 30 mg/l in the second pond. Suspended solids and COD reduction are commensurate with BOD reduction. E. Coli (MPN) was reduced in excess of 99.9% at a chlorine dosage of 20 lbs per day. Sterling Processing's waste load accounts for about 60% of the total waste load within the Garrett County Sanitary District. Original plans called for an activated sludge unit to treat the wastes from three communities and Sterling, with Sterling paying $194,000 of the $690,000 total cost, and an operating cost of $14,000/yr. Voters in the District rejected the facility, and Sterling was forced to build its own facilities at a cost of $84,000, for a savings of $109,000. (Makela-Texas)
W70-07488

A ROLE FOR REVERSE OSMOSIS IN A NEUTRAL SULPHITE SEMICHEMICAL PULP AND PAPERBOARD MILL,
Green Bay Packaging, Inc., Wis.
William R. Nelson, and Gerald O. Walraven.
Proceedings of the Industrial Waste Conference, 23rd, 1968. pt 2, p 540-549, 2 tab, 5 fig, 4 ref.

Descriptors: *Industrial wastes, *Pulp and paper industry, *Reverse osmosis, Water reuse, Treatment facilities, Sulfite liquors, Water pollution control, Pulp wastes, Waste water treatment, Tertiary treatment.

Water uses and waste water treatment schemes for a 210 ton per day semichemical pulp and paperboard mill are described. After laboratory studies have demonstrated the feasible application of reverse osmosis for the treatment of excess white-water and kraft thickener effluent, a full-scale plant will be expected to produce an effluent which is practically color free, odor free and nonfoaming from feed water containing 0.5 percent dissolved solids. Eighty-five to 90 percent of the total dissolved solids are expected to be present in the concentrate when the reverse osmosis unit operates between 5 and 15 gallons/sq.ft./day. A scheme for providing almost complete water reclamation and reuse within the plant is described. (Sorber-Texas)
W70-07489

THE MANAGEMENT AND DISPOSAL OF DAIRY MANURE,
Washington State Univ., Pullman. Coll. of Engineering.
Donald E. Proctor.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 554-566, 8 fig.

Descriptors: *Animal wastes, Management, *Farm management, *Dairy industry, *Algae, *Cattle, Slurries, Spraying, Activated sludge, Farm wastes.
Identifiers: *Manure, Anaerobic lagoon, Aerated lagoon.

Dairy manure can be either an asset or a liability depending on the farmer's management policies. Increased demand for livestock-derived products, specialization of farm operations, confinement rearing, cheaper chemical fertilizers, urban sprawl and farm area encroachment, and higher aesthetic standards are all facets of the changing problem of manure disposal. Of these changes, confinement rearing is most significant. Not only is the manure concentrated into a smaller area, but rainfall runoff can treble the waste volume to be handled. Two Washington State dairy farms received Federal Demonstration Project Grants, the Knott Dairy Farm of the Washington State University receiving a grant from the FWPCA, and the Monroe Honor Farm of the State of Washington Institutional Farm Industries receiving a grant from the Public Health Service. The two-year project at the Knott Dairy Farm proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure, (2) demonstrate the comparative capabilities and economics of activated sludge and naturally aerated lagoons for second stage treatment and (3) determine whether it is possible and practical to reduce the nitrogen and phosphorus content of the treated effluent by algae propagation and harvesting for use as cattle feed. The Monroe Honor Farm project proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure. (Makela-Texas)
W70-07491

TREATMENT OF A SLAUGHTERHOUSE WASTE USING ANAEROBIC AND AERATED LAGOONS,
Burns and McDonnell Engineering Co., Kansas City, Mo.
Allan H. Wymore, and James E. White.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 601-618, 3 fig, 14 tab.

Descriptors: *Efficiencies, Biochemical Oxygen Demand, Design criteria, Hogs, Organic loading, Waste water treatment, Industrial wastes.
Identifiers: *Aerated lagoons, *Anaerobic lagoons, *Slaughterhouse wastes, Diffused air tubing, Field surveys.

An extended aeration plant treating the wastes from a hog slaughterhouse located in Iowa Falls, Iowa was overloaded 230 percent of the original organic design load and 275 percent of the original hydraulic design load. A study indicated that it would be advantageous to abandon the existing treatment facilities and construct a new plant consisting of a lagoon system utilizing both anaerobic and aerated lagoons. The design kill rate was 3800 hogs per day. The lagoon system was preceeded by an air-flotation tank which averaged 34.9 percent BOD removal, hence, the design BOD discharged to the lagoon system was 5450 lbs/day. Two anaerobic lagoons, operated in parallel, received the effluent from the air-flotation tank and result in the removal of approximately 60 percent of the applied BOD at a loading rate of 15 lbs BOD/1000 cu. ft. The effluent from the anaerobic lagoons is discharged to two aerated lagoons operated in series and using 52,000 ft of diffused air tubing. The final effluent from the aerated lagoons has a BOD of about 35 mg/l which represents a 95 percent BOD removal within the aerated lagoon. The entire system is removing 99 percent of unfiltered BOD and 96.8 percent suspended solids. (Aguirre-Texas)
W70-07492

APPLICATION OF COMPUTERIZED ANALYSIS TO COMPARATIVE COSTS OF SLUDGE DEWATERING BY VACUUM FILTER AND CENTRIFUGE,
Quirk, Lawler and Matusky, New York.
Thomas P. Quirk.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 691-709, 11 fig, 6 tab.

Descriptors: *Sludge, *Dewatering, *Costs performance, Efficiency design, Sludge treatment, Sewage treatment.
Identifiers: *Centrifuge, *Vacuum filter, Moisture removal.

Analyses are presented which recognize the intermediate nature of the dewatering operation and provide for acceptance of the various limitations and controls imposed by upstream pretreatment and downstream final disposal. System analysis approach is taken to allow for both generalization and specificity needs to be served. Comparison between centrifuge and vacuum filter costs is made based on system analysis procedure for both general and specific installations. The procedure employed involves the following steps: (1) development of performance model for the unit operation and/ or the equipment under study, (2) use of field performance data to define the constants in the performance model, (3) development of a cost model for the unit operation and/ or equipment under study, (4) relation of cost of performance and, (5) use of computer facilities to execute the cost of performance relationship for any condition desired. Comparative cost analysis for a continuous sludge production rate of 750 lb/hour for the case studied favor the centrifugal dewatering. (See also W69-00338) (Shankar-Texas)
W70-07494

TRICKLING FILTER THEORIES,
Rice Univ., Houston, Tex.; and Ethyl Corp., Baton Rouge, La.
A. W. Bush, and G. A. Hughmark.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 766-771, 3 fig, 1 tab, 7 ref.

Descriptors: *Mathematical models, *Trickling filter, *Biological treatment, Dissolved oxygen, Computer program, Waste water treatment.
Identifiers: *Cell model, *Laminar model, Glucose, Inclined plate, Molecular diffusion, Eddy mixing, Aerobic, Anaerobic.

A mathematical model called cell method has been developed to simulate the biological treatment of a glucose solution on an inclined plate. The model considers consumption of glucose at the biological surface on the plate and diffusion of glucose and oxygen through the liquid film to the biological surface. A computer program was used for the cell method. The program was tested with several values of the consumption rate to attempt to match the experimental data for glucose, based upon carbon analysis as a function of distance down the inclined plate for an anaerobic run comparison of data calculated from the model and experimental data indicates that the liquid film flow is not laminar. The computer program is therefore revised to include a representation of eddy mixing. Good agreement is then obtained between calculated and experimental glucose concentrations. Aerobic runs were also made at various flow rates. (Shankar-Texas)
W70-07495

THE NITROGEN AND PHOSPHORUS REQUIREMENTS FOR THE BIOLOGICAL OXIDATION OF WASTEWATERS,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
Bernard R. Sachs, and Waldron D. Sheets.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 806-831, 18 fig, 2 tab, 21 ref.

Descriptors: *Activated sludge, *Biochemical oxygen demand, *Nitrogen, *Phosphorus, *Sugar beets, Industrial wastes, Waste water treatment.
Identifiers: *Optimum levels, *Requirements, *Treatment efficiency, Biological oxidation, Pilot-scale palnt, Warburg respirometer.

An investigation was conducted to determine (1) the optimum levels of nitrogen and phosphorus necessary to achieve the greatest oxidation in the shortest time for sugar beet waste water and (2) the best form of nitrogen to add to the waste water for such achievement. The average annual sugar consumption in the U. S. is nearly 10 million tons, one-third of which was produced from sugar beet in 1965. The study was divided into three phases. The initial phase dealt with the rate of oxidation, measured by a Warburg Respirometer, resulting from the addition of nitrogen and phosphorus compounds; the second phase was the operation of a batch and continuous flow pilot-scale activated sludge process for treatment of sugar beet wastes; and the concluding phase studied the response to

addition of the various nitrogen forms. The addition of nitrogen increased the rate of oxidation up to a four-day oxidation period. Optimum nitrogen levels ranged from 70 mg/l to 23 mg/l nitrogen for one to three-day oxidation periods. No additional phosphorus was needed since the rate was unchanged upon addition of phosphorus. Ammonium sulfate ($34 per ton) was the most effective as well as the most economical supplement material used. In a continuous flow activated sludge treatment with one-day aeration time, there was better than 80 percent reduction in consumed oxygen. (Aquirre-Texas)
W70-07496

EFFECT OF BORON ON AEROBIC BIOLOGICAL WASTE TREATMENT,
Delaware Univ., Newark.
Shankha K. Banerji, Brian D. Bracken, and B. M. Garg.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 956-965, 3 fig, 4 tab, 22 ref.

Descriptors: *Boron, *Toxicity, *Activated sludge, Chemical oxygen demand, Detergents, Surfactants, Waste water treatment.
Identifiers: Biological processes, Sludge synthesis, Settling characteristics.

Boron concentrations have been increasing in waste waters. High boron levels may be harmful to the operation of biological processes. Sludge was acclimated to a glucose and yeast substrate. This sludge was used to seed batch activated sludge units run on glucose and yeast substrate to which various amounts, zero to 200 mg/l, of boric acid or sodium borate was added. In almost all the systems having a boron addition the COD removal rate was lower than the control unit. The removal rate decreased somewhat exponentially with increase in boron concentration. The sludge synthesis coefficient remained practically constant even at high levels of boron. Settling behavior of the sludge was found to be somewhat adversely affected at concentrations greater than 100 mg/l of boron. Present levels of boron in domestic and laundry waste waters are low and there seems to be no great problem in biological treatment of such wastes. Adsorption or concentrations of boron on sludge may create situations where the toxicity may be significant. (DiFilippo-Texas)
W70-07498

REMOVAL OF ORGANIC COLLOIDS BY MICROFLOTATION,
Clarkson Coll. of Technology, Potsdam, N.Y.; and Cincinnati Univ., Ohio.
E. Alan Cassell, Alan J. Rubin, Howard B. Lafever, and Egon Matijevic.
Proceedings of the Industrial Wastes Conference, 23rd, 1968. p 966-977, 9 fig, 19 ref.

Descriptors: *Flotation, *Froth flotation, Wastewater treatment, Color, Coagulation, Bacteria, Aluminum tertiary treatment, Foam separation, Water reuse.
Identifiers: *Microflotation, pH, Frother, Collector.

Microflotation is a foam seperation process which, like conventional seperation, required the addition of a collector and a frother. Microflotation produces a thin, relatively dry foam and very low gas flow rates of fine bubbles are required. A laboratory batch system was used to investigate removal of several types of bacteria and removal of color from water. Lauric acid was used as the collector and ethaneol or isopropanol as the frother. Microflotation was studied at various pH values and with and without the additon of aluminum salts for coagulation. Data showed that E. Coli and materials which cause organic color are not removed in the absence of aluminum salts while under the same condition A. aerogenes and B. cereus are only partially removed. In the presence of aluminum salts all three types of bacteria and material which cause organic color are removed, the optimal pH being approximately 7.2. Requirements for successful microflotation include; maintenance of optimum pH and coagulant dosage; addition of proper collector and frother; and maintenance of an adequate gas flow for rapid seperation while not disturbing the flow. (DiFilippo-Texas)
W70-07499

REMOVAL OF ORGANIC REFRACTORIES BY REVERSE OSMOSIS,
Washington State Univ., Coll. of Engineering, Pullman.
Paul J. Bennett, Shyamala Narayarian, and Ervin Hindin.
Proceedings of the Industrial Waste Conference, 23rd, 1968. pt 2, p 1000-1017, 4 tab, 5 fig, 7 ref.

Descriptors: *Reverse osmosis, *Organic compounds, *Membranes, Tertiary treatment, Membrane processes, Industrial wastes, Effluents, Efficiencies, Water reuse.

A laboratory-scale reverse osmosis unit was employed to determine the efficiency of modified cellulose acetate membranes to reject organic refractories. The unit was operated at 100 atmospheres and flux between 5 and 25 gallons/sq.ft./day with varying feed concentrations. Pure solutions of 19 different chemical species were examined as well as 7 different mixtures. Rejections ranged between 14 and greater than 99.9%. In addition several species were mixed with trickling filter and activated sludge effluents resulting in reductions of between 21.4 and greater than 98% depending upon initial concentrations and operating conditions. Reverse osmosis is capable of producing a product water extremely low in organic matter excepting those organic compounds which have a vapor pressure higher than water when in solution or a dispersion. (Sorber-Texas)
W70-07501

DECISION FACTORS--SEPARATE INDUSTRY OR JOINT MUNICIPAL WASTE TREATMENT,
Weston (Roy F.), Inc., West Chester, Pa.
Francis A. Sanders.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1021-1028, 4 ref.

Descriptors: *Waste treatment, *Industry, Wastes, Costs, Toxicity, Industrial waste, Sewage treatment.
Identifiers: *Decision factors, *Community Sewage system, Laws, Legal implication.

The advantages and disadvantages are discussed to both industry and communities concerning the question of whether an industry should treat its own wastes or send them to a community sewage system. There are definite economical advantages to industry in the latter case, since capital and operating costs can be eliminated as an industry expense for the waste facilities constructed and operated by the community. Good relations are maintained when agreements can be reached to the satisfaction of the community and industry. Various factors which play a very important part in making the decisions are discussed. These include availability of land for industries to build treatment facilities, type of wastes, pretreatment requirements, the amenability of industrial wastes to biological treatment, toxicity, effect of certain wastes upon sewer material and the distance of the industry from community treatment plants. Futher the method of financing, statues, laws, legal implications, and equitable service charges should all be considered in making the final decision. (Shankar-Texas)
W70-07502

PACKAGE SLUDGE COMBUSTION FOR INDUSTRIAL WASTE TREATMENT PLANTS,
Dorr-Oliver, Inc., Stamford, Conn.
Robert J. Sherwood.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1029-1038, 8 fig, 2 tab.

Descriptors: *Industrial waste, *Treatment, *Sludge disposal, Centrifugation, Waste treatment.
Identifiers: *Combustion, *Scrubber, *Hydrocyclone, FS Disposal-Type CR.

The package sludge combustion system, called the FS Disposal-Type CR, is designed to receive a thickened degritted raw sludge, about three to five per cent total solids concentration and produce an inert ash. The following features make the FS Disposal-Type CR system well suited to meet industrial sludge disposal problems: (1) Combustion of 200 lbs of solids per hour can be accomplished in an area approximately 15 feet x 20 feet; (2) Start up and shut down costs are minimal, as the time required is less than 30 minutes; and (3) Three premounted sections provide for easy field connections and set up. The sludge combustion package consists of (1) A MercoBowl Centrifuge which concentrates the sludge from 4 percent to approximately 22 per cent solids; (2) A sludge combustion unit which operates at 1700 degree F; (3) A scrubber-dehumidifier; and (4) A hydrocyclone for ash concentration. The combustion unit works on the following principles. Concentrated sludge solids are sprayed radially towards the intensely heated walls of the combustion chamber. High velocity air preheated with combustion gases from the fuel burner is introduced tangentially into the cylindrical combustion chamber imparting a centrifugal force to the sludge particles giving them the necessary residence time required for combustion. (Galwardi-Texas)
W70-07503

THE TREATMENT OF PHENOLIC WASTES,
Emschergenossenschaft, Essen (West German).
Hans J. Wurm.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1054-1073, 20 fig, 2 tab, 8 ref.

Descriptors: *Industrial wastes, *Treatment, *Phenols, *Activated sludge, *Solvent extractions.
Identifiers: *Ifawol-dephenolization process, *Benzene-caustic-dephenolization process, *Phenosolvan-dephenolization process.

Various methods of removing phenols from industrial wastes are described. In 1966 the coke-oven plants and gas works of the Federal Republic of Germany produced over 65 million cu m of phenolic wastes with about 400 mg/l phenols. About 8,000 tons of phenols have been removed each year by the 21 dephenolating plants of Emschergenossenschaft and Lippeverband. By 1972 the present quantity of phenols in the Emscher River of about 10 mg/l will be reduced, by biological treatment, to less than 1 mg/l. Treatment of phenolic wastes consists of either recovery or destruction of phenols with recovery being only applied to quantities of water greater than 10 cu m/hr and phenol concentrations of at least 2 g/l. Phenol concentrations of 2,200 to 2,600 mg/l have been reduced to 30 mg/l using the benzene-caustic-dephenolization process and subsequent alterations. The phenosolvan-dephenolization process utilizing isopropyl ether as the solvent in a nine stage extractor has produced effluents containing less than 10 mg/l phenol. The ifawol-dephenolization process has obtained 99% removal of phenols from wastes containing 4 g/l phenol. The solvent used in this process is a residue product obtained during the extraction of higher alcohols from olefins. Texts have shown that the activated sludge process can remove phenols from a concentration of 10 mg/l to less than 1 mg/l with an aeration time of 90 minutes. (Galwardi-Texas)
W70-07504

ENVIRONMENTAL MANAGEMENT AT A MAJOR PETROCHEMICAL FACILITY,
Resource Engineering Associates, Inc., Stamford, Conn.
Robert N. Rickles.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1074-1088, 8 fig, 11 tab.

Descriptors: *Industrial wastes, *Treatment, *Deep well pumping, *Management, *Waste water treatment, *Control systems, Facilities.
Identifiers: *Acetaldehyde, Houston, Texas.

The program undertaken by the Celanese Corporation in the planning and development of a major new petrochemical facility located in the Bay Port Industrial Development at Houston, Texas, was discussed. Contact was made with all control agencies and discussions were held with their personnel with regard to the intended program. The results from an extensive air pollution survey of the site were presented. An evaluation of the aquatic environment of nearby Taylor Bayou was also conducted. The first unit constructed on the site was an acetaldehyde unit having a capacity of 175 million lbs/yr. The basic concept utilized for pollution prevention centered around minimization and control. Thus, it was necessary to have absolute control over all water streams in the developed plant minimized to prevent air pollution. (Galwardi-Texas)
W70-07505

FUNGUS CONTROL IN VACUUM FILTERS,
Metropolitan Sanitary District of Greater Chicago, Ill.
Gregory A. Ettelt, Evan N. Sakellariou, and Donald W. Harper.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1120-1133, 15 fig, 9 ref.

Descriptors: *Treatment, *Activated sludge, *Fungicide, Dewatering, Sewage treatment, Waste water treatment.
Identifiers: *Vacuum filters, *Blinding, *Fungal growth, Filter cloth, Caustic treatment, Fungal inhibition, Spray treatment.

Chronic blinding was investigated of vacuum filters as a result of fungal growth rather than particulate entrapment. Blinding of vacuum filters at Southwest plant resulted in loss of solids yield. Investigations showed that several types of fungi were involved and that blinding originated within the filter cloth. Backing deposits and increases in iron content within the deposits were found to be not relevant to the occurrence of blinding. Chemical treatment for cleaning the blinded filter have the disadvantage that the production decreases during the first stages of blinding and the loss of filter availability for about eight hours required for the cleaning treatment. Use of concentrated hydrochloric acid followed by two percent caustic was found to be more efficient in restoring filtration to blinded areas. An organotin-quaternary amine mixture completely inhibited fungal growth at 75 mg/l concentration in skae-culture tests. Continuous spray addition of the fungicide demonstrated adequate promise by preventing blinding of the filter cloth. (Shankar-Texas)
W70-07506

BIOLOGICAL TREATMENT OF ORGANIC PHOSPHORUS PESTICIDE WASTE WATERS,
Ryckman, Edgerley, Tomlinson and Associates, Inc., St. Louis, Mo.
C. Lue-Hing, and S. D. Brady.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1166-1177, 8 fig, 2 tab, 6 ref.

Descriptors: *Activated sludge, *Biological treatment, *Design criteria, *Industrial wastes, *Organo-phosphorus pesticides, Pilot plants, Waste water treatment.
Identifiers: *Pesticide industry, *Source control, Biological acclimation, Biological toxicity, Field studies, Laboratory studies, Phosphate removal, Waste water characterization.

The waste waters generated by Chemagro's manufacturing operations resulted in a water pollution problem which is unique among industrial wastes in general, although perhaps characteristic for the pesticide industry. The nature of the waste waters produced the following pollutional characteristics: (a) high BOD concentrations; (b) high COD concentrations, (c) moderate suspended solids concentrations; (d) biological toxicity; and (e) high organic phosphate concentrations. The ideal solution to any waste problem is the elimination or avoidance of the waste at the source. Chemagro's efforts in source control are aimed at the following areas: housekeeping, recovery/reuse, process modifications, segregation of waste, and pretreatment. Field and laboratory studies showed that the organic phosphorus component was amenable to chemical treatment, the BOD exerting component was biodegradable and could be treated by the activated sludge process under proper conditions of biological sludge acclimation. Since the biological responses to shock loading were very erratica and unpredictable, the decision was made to further study the treatment system in a field pilot plant installation. The pilot plant data indicates that the oxygen utilization rate of the sludge is 75 mg/l per hr at a MLSS concentration of 3270 mg/l. The biological removal of the dissolved organic material as measured by BOD was effective, since 90 to 98 percent reductions were realized during the pilot plant operation. (Aguirre-Texas)
W70-07507

STABILIZATION POND TREATMENT OF SLAUGHTER-HOUSE WASTES,
Japan Public Nuisance Lab., Tokyo.
Isamu Horasawa.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1178-1185, 3 fig, 6 tab, 9 ref.

Descriptors: *Hogs, *Lagoons, Algae, Organic loading, Waste water treatment, Water utilization, Industrial wastes, Oxidation lagoons.
Identifiers: *Japan, *Slaughterhouse wastes, Experimental studies, Lagoon design, Scale-up factors, Waste composition.

Wastes discharged from about 900 slaughterhouses in Japan, which kill approximately 6,000,000 animals per year, require a high degree of treatment to prevent water pollution and aesthetic nuisances of blood color and offensive odor. This experimental study was directed toward the use of the stabilization pond process by small slaughterhouses. The average water consumption by slaughterhouses located throughout Japan is about 848 liters per hog unit and the average BOD loading per hog unit is 1.255 kg. Four experimental stabilization pond units were run both in the laboratory and exposed to outside winter conditions. The BOD loading on the units ranged from 47 to 239 mg/l.These studies showed that, within the limits of laboratory scale testing, BOD loadings up to 100 mg/l (100 g/m2) can be tolerated without distinct aesthetic nuisance. The dominant algae in the ponds was Chlorella. The response to variation in weather conditions appeared to be dependent to some extent upon the BOD loading of the unit. The more heavily loaded units showed an indifferent response to weather change. Biochemical oxygen demand (BOD) loading for stabilization ponds is reported to range from less than 10 mg/l up to 150 mg/l depending on the dgreee of treatment required. (Aguirre-Texas)
W70-07508

THE CHARACTERISTICS AND POLLUTIONAL PROBLEMS ASSOCIATED WITH PETROCHEMICAL WASTES, SUMMARY REPORT,
Engineering-Science, Inc. Texas, Austin.
Ernest F. Gloyna, and Davis L. Ford.
Available from the Clearinghouse as PB-192310, $3.00 in paper copy, $0.65 in microfiche. Water Pollution Control Research Series, February 1970. 98 p, 17 tab, 13 fig, 120 ref. FWQA Program No. 12020---2/70, Contract No. 14-21-461.

Descriptors: *Oil wastes, *Waste water treatment, *Effluents, *Separation techniques, *Operating costs, Oily water, Chemical wastes, Organic wastes, Water pollution treatment, Industrial wastes, Effluent streams, Separation techniques, Water quality, *Operating costs, Emulsions, Water pollution effects, Oil industry, Water reuse, Reclaimed water, Waste water disposal, Cooling water, Biological treatment, Adsorption, Flotation, Oil-water interfaces, Solvent extractions, Coagulation, Oxidation, Oxidation lagoons, Biodegradation, Activates sludge, Trickling filters, Waste dilution, Biochemical Oxygen Demand, *Injection wells.
Identifiers: Inorganic wastes, Oil pollution effects, *Petrochemical wastes, Gravity separation, Waste stabilization ponds.

Each of the major processes developed by the industry should be studied with the objective of evaluating the trends in plant locations, effects onareawide water quality, and treatment requirements. Since there will be no significant changes in petrochemical feedstocks, the patterns of feedstock usage should be monitored and major changes evaluated in terms of the water use and water reuse requirements, potential pollution problems, and product development. Because the main contribution to environmental pollution from the petrochemical industry emanates from process waste streams, comparative cost analyses should be made on typical recycle (feedstock) practices and on associated waste water treatment requirements. A comprehensive and coordinated evaluation program should be developed specifically for standardizing the characterization techniques of wastewater containing complex and undefinable petrochemical and related wastewater constituents. Large volumes of wastewater could be reused within the plants with varying degrees of treatment; most wastewaters require some form of primary product recovery and treatment, oil removal, settleable solid removal, and reduction in the organic content. Master plan for in-plant wastewater collection should include facilities to segregate process waste from less contaminated streams. Problem areas in the physical, chemical and biological treatment processes, as well as disposal methods, are listed. A detailed and basic study should be initiated to evaluate the cost of treating wastes from single plants or process streams with combined wastes from several plants.
W70-07511

ELECTROPHORETIC WATER CLARIFICATION TECHNIQUES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
William M. Lyle, and Howard A. Hiler.
Water Resources Bulletin, Vol. 6, No. 2, p. 193-208, March-April, 1970. 13 fig, 13 ref. OWRR Project A-009-TEX (1).

Descriptors: Electrophoresis, Separation techniques, Water purification, Waste water treatment.
Identifiers: Suspended pollutants.

Only very recently has a limited amount of attention been focused directly on electrophoresis as a method for improving water quality. This approach has been proposed primarily as a method for removal of suspended colloidal material, although solutes can also be removed by this method. Electrophoresis is defined as the movement of charged suspended particles in a dc electric field. Several electrophoretic clarification systems and techniques have been developed and evaluated primarily for removing colloidal clay from suspension. The methods should apply equally well to any negatively charged particulate matter. Design for optimal clay removal efficiency and operating cost efficiency has been based upon previous theoretical results and upon modification of the combination filter-electrophoresis model for Bier. These systems and techniques along with the theoretical developments leading to their design are discussed. Results and conclusions are given for tests that have been concluded concerning the feasibility or practicality of these electrophoretic clarification systems for commercial use. These are viewed in light of various limiting factors such as electrical conductivity of the medium, quality of water desired, colloid concentrations and electrophoretic mobility of the suspended materials.

W70-07512

REMOVAL OF TRACE ORGANICS FROM WATER BY ADSORPTION ON COAL,
Virginia Polytechnic Inst., Blacksburg. Dept. of Sanitary Engineering.
Paul H. King.
Completion Report, March 1970. 6 p. OWRR Project A-015-VA (2).

Descriptors: Water pollution control, *Coal, Phosphates, *Adsorption, *Waste water treatment, *Phosphorous compounds, Pesticides.
Identifiers: *Trace organics, Resistant organics.

Laboratory investigations were conducted to determine the sorptive capacity of several grades of coal for selected biochemically resistant organic materials and for several phosphorus containing compounds. Both batch and continuous flow column studies were employed and data was obtained for uptake kinetics and sorptive capacity at equilibrium. Three representative pesticides, lindane, parathion and chlorisopropyl carbamate, and selected orthophosphate, metaphosphate and polyphosphate compounds were utilized. Significant differences in sorption with differing coals and solutes were noted. Some studies were also conducted for comparative purposes with activated carbon. The distribution of organic and phosphorus containing materials between the aqueous phase and the solid material is described by appropriate adsorption isotherms. (See also W70-05470)
W70-07559

5E. Ultimate Disposal of Wastes

SANITARY LANDFILL LOCATION STUDY.
Stark County Regional Planning Commission, Canton, Ohio.

Report available from Clearinghouse as PB-187 807, $3.00 in paper copy, $0.65 in microfiche. Stark County Regional Planning Commission, Canton, Ohio, Sept 1969. 84 p, 5 fig, 18 ref. Project No Ohio P-238 HUD.

Descriptors: *Landfills, *Waste disposal, *Hydrogeology, Water pollution control, Surveys, Leaching, Geology, Groundwater movement.
Identifiers: Stark County (Ohio).

Twenty-seven strip mine sites in Stark County, Ohio were analyzed as to their suitability for a sanitary landfill. Twelve of the 27 sites are recommended. The 12 sites recommended for a sanitary landfill are analyzed according to a list of geohydrological criteria. Each of the 12 sites is classified according to its major geohydrological characteristics and the types of waste materials acceptable to each class. Each site is described and analyzed on an individual basis according to: (a) location, land use and zoning, (b) size and ownership, (c) classification, suitability, and life expectancy, (d) potential reuse of the completed landfill, and (e) generalized analysis of geologic materials. (Knapp-USGS)
W70-07193

SOIL SYSTEMS FOR LIQUID WASTE TREATMENT AND DISPOSAL: ENVIRONMENTAL FACTORS,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
For primary bibliographic entry see Field 05D.
W70-07348

WATER -- 1969.
For primary bibliographic entry see Field 05G.
W70-07380

ULTIMATE DISPOSAL OF WASTE WATER: A PHILOSOPHICAL VIEW,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
Robert B. Dean.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 1-4, 1969. 4 p.

Descriptors: *Waste disposal, *Water pollution control, Waste water (Pollution), Sewage, Waste treatment, Byproducts, Water reuse, Economics, Ultimate disposal.

A proper understanding of ultimate disposal shows that there is no storage place that can be considered ultimate disposal for everything. The best that we can do is to put the individual elements back where they were before they started their long journey to the sewage treatment plant. This means carbon dioxide back via the atmosphere to the immense buffer system of the ocean, nitrogen back to nitrogen gas in the atmosphere, calcium back to the land or stones, etc. The ocean is ultimate disposal for sodium chloride, but it is not ultimate disposal for DDT or mercury salts. (See also W70-07380). (Knapp-USGS)
W70-07381

ULTIMATE DISPOSAL OF WASTES TO SOIL,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. C. Routson, and R. E. Wildung.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 19-25, 1969. 7 p, 40 ref. AEC Contract AT (45-1)-1830 and FWPCA Contract No 14-12-508.

Descriptors: *Waste disposal, *Soils, *Landfills, *Soil disposal fields, Nutrients, Toxicity, Pesticides, Inorganic compounds, Poisons, Radioactivity, Absorption, Adsorption, Water reuse, Soil chemical properties, Soil chemistry, Organic matter.
Identifiers: Disposal in soil.

The soil is a suitable medium for the ultimate disposal of wastes which will either be transformed to innocuous forms or recycled and removed as agricultural crops. Thus, ultimate soil disposal should be limited to major plant nutrient elements, radionuclides with practical half-lives, and biodegradable organic materials. Efficient soil sorption should not be the sole criterion used in evaluation of the soil as a medium for waste disposal. For example, heavy metal solutions can be decontaminated by soil percolation, but many are toxic to plants even in small quantities. The rate and extent of recyclization or dissipation of soil amended inorganic or organic wastes will be dependent upon the properties of the waste and of the soil. (See also W70-07380). (Knapp-USGS)
W70-07383

DISPOSAL OF EFFLUENTS FROM DESALINATION PLANTS,
Dow Chemical Company, Freeport, Tex.; and Texas A and M Univ., College Station.
M. A. Zeitoun, W. F. McIlhenny, and R. O. Reid.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 156-166, 1969. 11 p, 9 fig, 2 tab, 14 ref. Office of Saline Water Contract No 14-01-0001-1161.

Descriptors: *Ultimate disposal, *Brines, *Desalination plants, Desalination processes, Heated water, Thermal pollution, Water pollution control, Diffusion, Dispersion, Mathematical models, Hydraulic models, Jets, Waste water disposal.
Identifiers: Desalination plant effluents.

Heat, salinity, and copper are the critical pollutional parameters of desalination plant effluents. The dispersion of the dense effluent into sea water was studied in a laboratory model. An approximate analytical solution of the differential equations governing the flow and density distribution for an upwardly projected dense jet was obtained. The proportionality of the average height of dense jets to the flow conditions and density differences was established experimentally. The distribution of dye concentration across the jet was found to be Guassian, with two distinctly different slopes identifying a middle region of upward flow, surrounded by an outer region of downward flow. Turbulent diffusion coefficients inside the jet have been calculated. This information is being used for the design of outfall systems from desalination plants. (See also W70-07380) (Knapp-USGS)
W70-07391

DEEP-WELL DISPOSAL OF STEEL MILL WASTES,
National Steel Corp., Portage, Ind. Midwest Steel Div.
C. D. Hartman.
Journal Water Pollution Control Federation, Vol 40, No 1, p 95-100, Jan 1968. 6 fig, 2 tab.

Descriptors: *Sludge disposal, *Injection well, *Acids, *Steel, Industrial wastes, Sludge treatment, Lagoons, Groundwater, Geology, Costs, Filtration, Disposal, Waste disposal.

The large accumulation of sludge as well as the increasing production of sludge at the Midwest Steel Mill forced investigation of an altemate disposal method to its overtaxed sludge lagoons. Deep-well injection was considered and geological investigation showed that a water-filled sand stone formation approximately 2,500 feet thick was located about 2,000 feet beneath the Midwest plant site. The injection tube is a 3-inch fiberglass pipe which is resistant to the waste pickle acid. Before injection the acid is filtered to eliminate particles larger than 0.5 microns. The new process has reduced sludge accumulation by 70%. A flow of 75 gal/min has been operating for 18 months with no pressure required. The monthly waste disposal costs have been reduced from $33,000 for lime neutralization to $5,200 for the deep-well injection. (Hancuff-Texas)
W70-07447

DALE V BEDAL (IMPLIED EASEMENT FOR SEWAGE DISPOSAL).
For primary bibliographic entry see Field 06E.
W70-07647

5F. Water Treatment and Quality Alteration

FACTORS INFLUENCING THE HERBICIDAL EFFICIENCY OF MCPA AND MCPB IN THREE SPECIES OF MICRO-ALGAE,
University of Strathclyde, Glasgow (Scotland). Dept. of Biology.
R. C. Kirkwood, and W. W. Fletcher.
Weed Research, Vol 10, No 1, p 3-10, 1970. 2 fig, 3 tab, 12 ref.

Descriptors: *Chlamydomonas, *Algae, *Herbicides, Pesticides, Chlorella, Respiration, Phosphorus, Toxicity, Radioisotopes, Inhibition.
Identifiers: *Chlorinated herbicides, MCPB, MCPA, Chlamydomonas globusa, Chlorella pyrenoidosa, Stichococcus bacillaris, Undissociated molecules, Algal growth.

The relative herbicidal effectiveness of MCPA (4-chloro-2-methylphenoxyacetic acid) and MCPB (4- (4-chloro-2-methylphenoxy) butyric acid) was appraised by using as test plants three spp of unicellular algae. The algae were grown in nutrient solutions of pH 6.5 in 10-1 aspirators. The herbicides were C-14-carboxyl-labelled. MCPB inhibited growth, respiration, and phosphorus uptake more than MCPA and was toxic at the minimum concentration of 0.0025 moles. The enhanced herbicidal effect of MCPB coincided with its increased absorption. Both herbicides inhibited phosphorylation. Optimum uptake of herbicides was at pH values favoring movement of undissociated molecules. (Wilde-Wisconsin)

W70-07255

AUTOMATIC COOLING TOWER CONTROL,
Magna Corp., Santa Fe Springs, Calif.
H. Fietler, and C. R. Townsend.
Chemical Engineering Progress, Vol. 65, No. 5, p 63-67, 1969.

Descriptors: *Thermal pollution, *Cooling towers, *Control, Cooling, Evaporation, Automatic control, Recirculated water, Water quality, Dissolved solids, Water quality control.

The effect of heat discharged from electric steam power plants on rivers is discussed. Comparison between once-through condenser cooling systems and cooling tower systems is made from the thermal pollution standpoint. Potential problems in the latter system can be minimized by reducing the amount of bleed-off water put to waste and by reducing the concentration of chemicals added to the cooling water. The tower controller is an automatic system for controlling tower water scale and corrosion treatment by measuring and controlling within present limits, the water's pH, TDS, inhibitor level and corrosion rate. The major functional and operational concepts utilized in the tower controller were presented. Generalized economic data showed that labor and chemical savings could pay for the equipment in one year while reducing both thermal and chemical pollution. (Novotny-Vanderbilt)
W70-07322

TOXICOLOGICAL ASPECTS OF WASTE-WATER RECLAMATION--A PRELIMINARY REPORT,
California State Dept. of Public Health, Berkeley. Sanitation and Radiation Lab.
For primary bibliographic entry see Field 05C.
W70-07350

5G. Water Quality Control

NEUTRALIZATION OF HIGH FERRIC IRON ACID MINE DRAINAGE,
Federal Water Quality Administration, Norton, W. Va. Norton Mine Drainage Field Site.
For primary bibliographic entry see Field 05D.
W70-07149

OPTIMAL RESERVOIR RELEASES FOR WATER QUALITY CONTROL,
Federal Water Quality Administration, Annapolis, Md. Chesapeake Technical Support Lab.; and Michigan Univ., Ann Arbor. Dept. of Sanitary and Water Resources Engineering.
Norbert A. Jaworski, Walter J. Weber, Jr., and Rolf A. Deininger.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA3, Paper 7361, p 727-742, June 1970. 16 p, 8 fig, 3 tab, 18 ref, append.

Descriptors: *Reservoir operation, *Water quality control, *Mathematical models, *Optimization, Flow augmentation, Systems analysis, Water quality, Water storage.
Identifiers: Reservoir release planning.

A general mathematical model for determining optimal flow release sequences for water quality control from multiple reservoir systems is presented. The model defines an optimal release sequence which provides either the 'best quality of water' or the 'least cost of reservoir storage' for a given streamflow at a particular point in the system. Using the converging-branch multistage system of dynamic programming, the flow release problem is decomposed into a sequence of subproblems or stages. At each stage or decision point, which represents a confluence of two regulated streams, optimal release sequences are obtained by an efficient enumeration process. The flow release model incorporates formulations for BOD, DO, temperature, and physical relationships for streamflow, velocity, and depth. The facility of examining intermediate solutions at individual stages and the elimination of the need for continuous differential return functions are two of the principal features of the model. (Knapp-USGS)
W70-07150

A BIBLIOGRAPHY OF BOOKS ON THE ENVIRONMENT -- AIR, WATER AND SOLID WASTES,
Toledo Univ., Ohio. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 10.
W70-07190

SANITARY LANDFILL LOCATION STUDY.
Stark County Regional Planning Commission, Canton, Ohio.
For primary bibliographic entry see Field 05E.
W70-07193

RESEARCH DEVELOPMENT AND DEMONSTRATION PROJECTS, Division of Applied Science and Technology.
Federal Water Quality Administration, Washington, D.C.

Available from the Clearinghouse as PB-192 091, $3.00 in paper copy, $0.65 in microfiche. FWQA Report, April 1, 1970. 337 p. FWQA Project 10000---4/70.

Descriptors: *Industrial water, *Water pollution control, Waste water treatment, *Water reuse, *Water pollution treatment, Industries, Water quality, Water requirements.
Identifiers: Industrial pollution control, Municipal pollution control, Agricultural pollution control, Mining pollution control.

A total of 331 information sheets were compiled in the following descriptive categories: Municipal-pollution control technology (88); Industrial-pollution control technology (112); Agricultural-pollution control technology (26); Mining-pollution control technology (44); Other-sources-of-pollution control technology (36); and Water resources planning and resources data (25).
W70-07230

PROBABALISTIC CONSIDERATIONS IN WATER QUALITY MANAGEMENT,
Illinois Univ., Urbana.
Ben B. Ewing.
Proceedings of the Water Resources Seminars 1968-1969, University of Delaware, Newark, December 1969, p 65-79. 4 fig, 1 tab, 10 ref.

Descriptors: *Probability, *Water quality control, *Stochastic processes, *Biochemical Oxygen Demand, *Dissolved oxygen, Markov processes, Ohio River.
Identifiers: Streeter-Phelps equation.

The results of studies concerned with the application of the theories of probability to water quality management were reported. Previous investigations on the development of a stochastic model for water pollution problems based upon a Markov Chain model and on the recognition of the random nature of dissolved oxygen response to biochemical oxygen demand loads or to stream discharge were cited. Specifically, the classical work of Streeter and Phelps done on the Ohio River, concerning biochemical oxygen demand (BOD) relationships was described and expanded. Dissolved oxygen relationships were also analyzed and examples of the work were given. It was concluded that further research is needed to apply the laws of probability to the Streeter-Phelps and modified Streeter-Phelps equations and that the application of probabilistic models should be extended to describe the response of a stream to other pollutants such as radioactive materials, dissolved materials and trace organic compounds. It was proposed that the real key to the development of further probabilistic concepts in water quality management is the availability of large data banks of field data. (Kriss-Cornell)
W70-07240

OPTIMIZATION: THEORY AND PRACTICE,
Heriot-Watt Univ., Edinburg (Scotland).
For primary bibliographic entry see Field 06A.
W70-07251

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

TREATMENT OF MINE DRAINAGE BY INDUSTRY IN PENNSYLVANIA,
Pennsylvania Dept. of Health, Harrisburg. Div. of Mine Drainage.
For primary bibliographic entry see Field 05D.
W70-07346

PROCEEDINGS FLORIDA'S ENVIRONMENTAL ENGINEERING CONFERENCE ON WATER POLLUTION CONTROL.

Available from College of Engineering, Univ. of Florida, Gainesville, Fla. - Price $5.00. Florida Univ. Engineering and Industrial Experiment Station Bulletin Series 135, Vol 24, No 3, March 1970. 168 p. OWRR Report A-999-FLA (3).

Descriptors: *Water pollution control, *Florida, Eutrophication, Waste treatment, Waste disposal, Water quality, Lakes, Estuaries, Streams, Monitoring, Water management (Applied), Urbanization, Pesticides, Environmental effects, Water law, Water quality act, Planning, Cities.
Identifiers: Water quality conference.

The Proceedings of a conference held to discuss water pollution control in Florida includes papers by engineers and scientists from all levels of government and from industry and universities. A review of water pollution problems was made as they relate to streams, lakes, estuarine and coastal waters, and the underground waters of the State. Problems of discharging inadequately treated wastes into the usable aquifers of the State, the eutrophication of fresh-water lakes, including the classic case of Lake Apopka, the degradation of streams, and continuing change in ecosystems of our estuarine and coastal waters are discussed. Methods for controlling water pollution include the physical, chemical, and biological aspects of stream monitoring, basin management as a means of water pollution control, control of pollution in estuarine water, advanced waste treatment techniques for nutrient removal, control and removal of pesticides, ecological management as a means of water pollution control, and preservation and restoration of lakes. Reviews of federal, state and local water pollution legislation, as well as regional planning as a means of water pollution control, were presented. (Knapp-USGS)
W70-07371

QUALITY ASPECTS OF FARM WATER SUPPLIES.
Victorian Irrigation Research and Advisory Services Committee, Melbourne (Australia).

Department of National Development, Australian Water Resources Council Publication, Canberra, 1969. 45 p, 1 fig, 8 tab, 5 ref, 4 append.

Descriptors: *Water quality, *Irrigation water, *Domestic water, *Stock water, Water resources, Water supply, Surface waters, Water chemistry, Mineralogy, Groundwater.

Identifiers: Queensland (Australia), Water quality requirements.

Criteria for suitability of water for farm uses are given in a report intended for practical use by farmers. Uses for which quality aspects are listed include irrigation, stock, domsestic, dairy, spray mixing, and concrete making. Although the discussion includes much information specific to the water problems of Queensland, Australia, there is enough of general interest for use anywhere. The quality of a water supply is judged by the amounts of dissolved and suspended materials which are invariably present. Thus, in an absolute sense, high quality in a water is associated with low amounts of such materials. However, in practice, quality must always be considered in relation to the intended use of the water, and a supply which is of high quality for one purpose may be of low quality for another. Quality depends in the first place on the source of the water supply. Subsequently, deterioration during storage on the farm may occur and become important in some circumstances. Organic pollution is the most common cause of deterioration in the quality of waters held in dams, wells, and tanks, and is of concern mainly where the water is required for human consumption. Occasionally, waters held in dams or troughs may deteriorate as a consequence of high evaporative losses and become unsuitable for irrigation or stock because of the increased concentration of soluble salts. (Knapp-USGS)
W70-07375

WATER -- 1969.

Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, 1969. 315 p.

Descriptors: *Ultimate disposal, *Water pollution control, *Water pollution treatment, *Conferences, Waste water treatment, Desalination, Water reuse, Injection wells, Soil disposal fields, Radioactive wastes, Eutrophication, Water management (Applied), Economics, Oily water.
Identifiers: Waste management symposium.

A symposium collection presents 43 papers on the general subject of ultimate disposal of wastes or pollution control. The topics include injection well practices, soil disposal-fields, radioactive waste management, disposal to bodies of water, thermal waste disposal, quality standards, water reuse, waste management, pollution surveys, water pollution treatment, economics of waste management, waste treatment technology, desalination, eutrophication, and oil spill control. (See also W70-07381 thru W70-07393). (Knapp-USGS)
W70-07380

POLLUTION IN THE MISSISSIPPI RIVER,
Federal Water Pollution Control Administration, Chicago, Ill.; and Federal Water Pollution Control Administration, Dallas, Tex.
For primary bibliographic entry see Field 05B.
W70-07384

THE LOUISIANA STREAM CONTROL COMMISSION'S WATER QUALITY STANDARDS AND PROGRAMS FOR THE LOWER MISSISSIPPI RIVER,
Louisiana Stream Control Commission, Baton Rouge.
Robert A. Lafleur.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 51-52, 1969. 2 p.

Descriptors: *Water quality control, *Legislation, *Standards, *Louisiana, Water utilization, Water quality, Water pollution control.
Identifiers: Louisiana water quality standards.

The standards and programs for control of the quality of water in the lower Mississippi River are described. In addition, the development of these standards by the Louisiana Stream Control Commission is discussed. Water quality standards for the Mississippi River as well as for all streams in Louisiana were developed in accordance with present uses, anticipated uses, and approximately 8 yr of water quality monitoring data. The recognized uses are: potable and industrial supplies; navigation; limited noncontact recreation; propagation of aquatic life, including shellfish; sport and commercial fishing; irrigation; and the carriage of treated municipal and industrial waste. Consideration was also given to the fact that there will be significant increases in the use of the Mississippi River for potable supplies, industrial supplies, navigation, and irrigation. (See also W70-07380). (Knapp-USGS)
W70-07385

FREEPORT SULPHUR COMPANY'S POLLUTION CONTROL PROGRAM (SPECIAL REFERENCE TO OFFSHORE),
Freeport Sulphur Co., Belle Chasse, La.
Frederick G. Deiler.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 53-63, 1969. 11 p, 16 fig, 2 tab, 2 ref.

Descriptors: *Water pollution control, *Waste water disposal, *Monitoring, *Water quality, *Louisiana, Water analysis, Water chemistry, Sampling, Sulfur, Sulfur compounds, Brines, Saline water, Sea water, Aquatic environment, Aquatic microorganisms.
Identifiers: Sulfur mining, Frasch process.

Freeport Sulphur Company operates five mines in the Gulf Coastal area of Louisiana. At each, the Frasch process of mining is used, necessitating the constant removal of cooler formation water at the flanks of the dome. This waste water, known as bleedwater, totals millions of gallons per day. The Company employs a program of surveillance to assure that the waste disposal is satisfactory and harmless to aquatic life, and that the quality and quantity of the discharge is consistent with the provisions stipulated in the Stream Control Commission permits. The program of surveillance employs routine water sampling for chemical analyses, accompanied by physical measurements. Comprehensive quarterly surveys are conducted at all locations, and these include chemical, physical, and biological measurements but feature the biological parameter. Methods and instruments used to obtain water samples for chemical analyses, sampling gear, and other instruments used in the program are fully described. (See also W70-07380) (Knapp-USGS)
W70-07386

OIL SPILLAGE CONTROL,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
W. H. Swift, C. J. Touhill, and P. L. Peterson.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 265-273, 1969. 9 p, 10 ref.

Descriptors: *Oily water, *Water pollution control, *Water pollution treatment, Biodegradation, Chemcontrol, Aquatic environment, Aquatic habitats, Water pollution effects.
Identifiers: Oil spillage control.

The current state of technology of prevention and control of major oil spillage on water, the restoration of the shore face and waterfowl, and the effects of oil pollution and defensive measures on aquatic life are reviewed, with emphasis on the control aspects including surveillance and prediction of slick movement, chemical treatment of slicks (collection and dispersion), biodegradation of oil in the ocean, booming, burning, skimming, and the treatment and disposal of recovered slicks. Procedures are recommended for oil spillage control, and research needs are identified. (See also W70-07380) (Knapp-USGS)
W70-07392

THE SCIENTIFIC APPROACH TO THE PROBLEM OF OIL POLLUTION,
For primary bibliographic entry see Field 05C.
W70-07416

DISPERSAL OF OIL SLICKS IN PORTS AND AT SEA,
Standard Oil Company of New Jersey.
For primary bibliographic entry see Field 05C.
W70-07417

PARAFFIN FOR OIL POLLUTION OF THE SEA,
Campsa's Central Lab., Madrid (Spain).
E. Castellanos.
International onference on Oil Pollution of the Sea, Rome, p 239-241, Oct 7-9, 1968.

Descriptors: *Water pollution control, Oil wastes, *Oily water, Water quality control, *Water pollution treatment.
Identifiers: *Paraffin, Oil pollution.

When breaks occur in the tanks of tankers, oil spillage can be avoided by solidifying the petroleum with paraffin. Using a small boat, melted paraffin can be projected into polluted ports daily and collected when solid masses form. Oil from marine catastrophes can be solidified by projecting paraffin from the heated tanks of a tanker and can then be collected with dragnets. Paraffin is advantageous because it has a great affinity for oil and transforms the oil into a solid that is easily collected. Paraffin, is relatively inexpensive because it is an excess refinery product. (See also W70-07411) (Harbert-Washington)
W70-07418

BOLLINGER V MUNGLE (WELL POLLUTION; NEGLIGENCE IN CONSTRUCTION AND INSTALLATION OF GAS TANKS).

175 SW2d 912-917 (Mo Ct App 1943).

Descriptors: *Missouri, *Wells, *Water pollution, *Gasoline, Seepage, Land, Land tenure, Legal aspects, Judicial decisions, Damages, Groundwater, Storage, Underground storage, Storage tanks, Repairing, Water wells.
Identifiers: *Nuisance.

Plaintiff brought suit against defendants for damages caused by contamination of a well on her land. One of the defendants had constructed a gasoline pump and underground tank on another defendant's land adjacent to plaintiff. After construction, gasoline began to appear in plaintiff's well. Plaintiff based her suit on negligence of the defendants. The trial resulted in a verdict against one of the defendants but the court sustained a motion for a new trial because of an insufficiency of evidence to establish negligence. Plaintiff appealed, contending that she did prove negligence, but that in any event the pollution constituted a nuisance by defendant and proof of negligence was not necessary. The court of appeals affirmed the trial court. Plaintiff based her action on negligence and could not change her theory to nuisance on appeal. In the trial she failed to carry the burden of proof either by showing negligence on the part of defendant in construction and installation of the tank or failure to remedy or repair its defects. She did show contamination of the well with gasoline but the probative value of this was insufficient to establish defendants' negligence. (Duss-Florida)
W70-07424

ENERGETIC ENFORCEMENT OF INDUSTRIAL WASTE ORDINANCES,
Metropolitan Sanitary District of Greater Chicago, Ill.

For primary bibliographic entry see Field 06E.
W70-07490

SCOTTISH RIVER PURIFICATION BOARDS,
Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 06E.
W70-07566

SQUAW ISLAND FREIGHT TERMINAL INC V CITY OF BUFFALO (ACTION TO ENJOIN THE POLLUTION OF A RIVER BY SEWAGE DISPOSAL).

273 NY 119, 7 NE2d 10-18 (1937).

Descriptors: *New York, *Water pollution, *Sewage disposal, *Cities, Navigable rivers, Judicial decisions, Legal aspects, Banks, Boundaries (Property), Ownership of beds, Fresh-water, Riparian rights, River beds, River flow, Islands, Dredging, Self-purification, Sewers, Outlets, Drainage system, Natural flow doctrine, Competing uses, Administration, Municipal water, Reasonable use, Relative rights, Damages, Permits, Water pollution sources, Navigation, State governments.

Plaintiff brought suit to enjoin defendant city from committing a permanent, continuing trespass by emptying its sewage into the Niagara river and thus causing pollution of plaintiff's land. Plaintiff owned a portion of an island in the river and thirty acres of underground land upon which they had performed dredging operations under federal licenses. Defendant had state legislative authority to dispose of sewage into the river. The appellate court, in answering certain questions propounded by the lower court and in affirming judgement for plaintiff, found that while riparian owners are not entitled to have tidal waters pass their land free of pollution, the pollution must not result in a direct trespass or nuisance to the property or the riparian owners. The authority to dispose sewage was not authority to commit a direct trespass. Defendant's contention that plaintiffs were contributorily negligent in that their dredging caused the sewage to be drawn to their land was rejected. (Barnett-Florida)
W70-07604

ELMORE V INGALLS (COAL MINE POLLUTION).
17 So 2d 674-677 (Ala. 1944).

Descriptors: *Alabama, *Water pollution, *Coal mine wastes, *Natural flow doctrine, Judicial decisions, Riparian rights, Water pollution sources, Coal mines, Mining, Industrial water, Reasonable use, Relative rights, Riparian land, Water utilization, Impaired water quality, Streams, Running waters, Degradation (Stream).

Plaintiff constructed his home downstream from defendant's coal mining operation. Evidence showed that by conducting coal washing operations on the stream banks defendant had substantially impaired the quality of the water. The court held that every riparian proprietor has an equal right to the stream flow through his land in its natural state, although each is entitled to the reasonable use of the water for domestic, agricultural or manufacturing purposes. Recognizing that the public interest favoring industry prevented liability for slight inconveniences or occasional annoyances to those downstream, the court held that the water could not be so polluted as practically to destroy or greatly impair its value to the lower riparian proprietor. Plaintiff's complaint was held to have stated a cause of action. (Douberley-Florida)
W70-07607

DRAINAGE--SANITARY DISTRICTS (STRUCTURE, FORMATION AND ADMINISTRATION).
For primary bibliographic entry see Field 04A.
W70-07618

DRAINAGE - SANITARY DISTRICTS (WASTE DISPOSAL; ACQUISITION AND USE OF PUBLIC PROPERTIES; CONDEMNATION; SEWAGE TREATMENT).
111 Ann Stat ch 42, secs 283, 284, 289, 291, 292 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage districts, *Sewage districts, *Waste disposal, Public rights, Administration, Right-of-way, Water supply, Local governments, Governments, Legislation, Water management (Applied), Water policy, Water law, Drainage, Condemnation, Easements, Cost repayment, Eminent domain, Legal aspects, Facilities, Sewage, Waste treatment, Damages.

The trustees of any sanitary district are empowered to dispose of sewage and control water quality in the district through the use of the facilities of the district and, by agreement, the facilities of other districts. The trustees must prevent contamination of lakes resulting from sewage discharge. No district may discharge sewage into Lake Michigan unless the treatment thereof meets the requirements of state and federal law. When no agreement may be reached upon the terms under which one sanitary district may use the facilities of another, the right to use may be required by condemnation, with compensation as provided by the court. Sanitary districts are empowered to extend their facilities along, under, upon and across highways, streets, and public ground, but without incommoding the public use thereof. Subject to approval by the Governor and public rights of commerce and navigation, districts may construct facilities in, along, or upon lands owned by the state beneath public waters. Damages to private property caused by district activity must be compensated before payment of any other debt. The district may acquire public property, but must restore it to its former usefulness as soon as practicable. (See also W70-07618). (Dye-Florida)
W70-07621

WATER SUPPLY (POLLUTION ABATEMENT).
Pa Stat Ann tit 35, secs 691.601-691.701 (1964), as amended, (Supp 1970).

Descriptors: *Pennsylvania, *Pollution abatement, *Water pollution control, *Public health, Legislation, Water pollution sources, Public rights, Water supply, Sewage, Municipal wastes, Industrial wastes, Sewage treatment, Relative rights, Regulation, Governments, Remedies, Local governments, Legal aspects, Adjudication procedure.

Suits to abate pollution of any waters of Pennsylvania may be instituted in law or equity in the court of common pleas in Dauphin County or in any county in which the polluted water flows. Reasonable time may be permitted for the abatement of the pollution. A mandatory preliminary injunction may be issued where public health is endangered. Summary proceedings under the provisions of this act may be brought before any magistrate, alderman or justice of the peace in the county affected or in the county where the offense occurred. An injunction may be issued against any municipality or person even though there are other contributors to the pollution. Records of applications and proceedings are open to public inspection. A reasonable fee may be required upon filing an application. All rules and regulations established by the board or the Secretary of Health prior to this act are to continue in effect unless otherwise modified. Appeals may be taken to the court of common pleas, Dauphin County. The Commonwealth may act to abate any pollution even after a penalty has been collected. (Hubener-Florida)
W70-07623

SWIFT AND CO V PEOPLES COAL AND OIL CO (LIABILITY FOR UNDERGROUND OIL SEEPAGE).
186 A 629-635 (Conn 1936).

Descriptors: *Connecticut, *Oily water, *Underseepage, *Pollution, Judicial decisions, Oil, Seepage, Damages, Oil industry, Storage tanks, Subsurface drainage, Underflow, Underground streams, Percolating water, Subsurface waters, Underground, Leakage, Percolation, Water rights, Water pollution sources, Groundwater, Groundwater movement, Permeability, Legal aspects.

Plaintiff sued defendant oil company for damages resulting from oil seepage into plaintiff's cellar. Dye tests showed that water percolated from defendant's property into plaintiff's cellar, and since there was a considerable amount of free oil on defendant's property the court found that to be the source of oil on plaintiff's premises. The court held that the absolute right a landowner has to use underground waters does not carry with it a right to make that water unuseable for others. A landowner's rights are restricted when he knows or should know that his use of his land will cause injury to another. The pollution of subterranean waters was held to be a nuisance without a showing of negligence. The rule that removed liability for pollution brought to another's lands by subterranean currents was overruled. Although he leased the property to the oil company, defendant landowner was also held liable because he renewed the lease to defendant oil company without abating the known nuisance. (Douberley-Florida)
W70-07631

JACKSON V UNITED STATES PIPE LINE CO (LIABILITY FOR UNDERGROUND OIL SEEPAGE).
325 Pa 436, 191 A 165-166 (1937).

Descriptors: *Pennsylvania, *Oily water, *Pipelines, *Leakage, Judicial decisions, Oil, Oil industry, Subsurface drainage, Water pollution sources, Pipes, Closed conduits, Metal pipes, Wells, Artesian wells, Water wells, Inflow, Underground, Groundwater, Water supply, Seepage, Infiltration, Water pollution, Pollutants, Legal aspects.

Defendant operated a pipe carrying oil across plaintiff's property at a higher elevation than plaintiff's water well. Upon discovering substantial amounts of oil in his well, plaintiff sued for damages. The court found that the evidence was sufficient to justify a verdict in favor of plaintiff, even in the absence of direct proof of leakage from defendant's pipe. A section of the pipe that was replaced was found to have holes in it, and subsequent to the replacement the oil content in the well was substantially reduced. The ground sloped downward from the pipe to plaintiff's well, and there were no other possible sources for the oil in the vicinity. An experienced well driller testified that the oil came from the defective pipe line. Under the applicable statute the defendant was held to be liable without a showing of negligence since oil from its pipe was found to have polluted the well. (Douberley-Florida)
W70-07632

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02A.
W70-07232

TECHNIQUES FOR EVALUATING LONG-TERM RESERVOIR YIELDS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Augustine J. Fredrich.
Paper presented at ASCE National Meeting on Water Resources Engineering, New Orleans, Louisiana, February 8, 1969. 14 p, 8 fig, 8 tab, 4 ref.

Descriptors: *Reservoir yield, *Streamflow forecasting, *Routing, *Computer programs, Optimization, Estimating, Reservoir operation, Water supply, Safe yield, Probability, Statistical methods.
Identifiers: Reservoir yield forecasting.

The effects of some basic assumptions of simplified methods of reservoir yield forecasting are demonstrated so that techniques may be chosen to produce the desired results with the best expenditure of time, funds, and manpower. The techniques for evaluating long-term reservoir yield may be divided into two general categories: (1) non-sequential methods which generally consider only the quantity of water available; and (2) sequential methods which consider both the quantity of water available and its time distribution. The three factors about which assumptions are frequently made in the simplified techniques are evaporation, seasonal variation in demand, and drought duration. Storage requirements to meet a given yield may be underestimated by more than 40% if evaporation and seasonal variation are ignored when they are actually significant. None of the simplified techniques are capable of accounting for all of the factors which affect the yield in a complex multiple-purpose project. The capability now exists to perform these sequential routings by electronic computer, even in the initial planning phases of a study. Furthermore, these routings may be used with generated streamflow data. (Knapp-USGS)
W70-07234

A MODEL OF RATIONAL COMPETITIVE BIDDING,
Shell Development Co., Modesto, Calif.
Michael H. Rothkopf.
Management Science, Vol 15, No 7, March 1969, p362-373. 1 tab, 20 ref, 1 append.

Descriptors: *Mathematical models, *Optimization, *Bids, *Equilibrium, Profit, Decision making.
Identifiers: *Auctions, *Strategies, Highest-bid-wins, Lowest-bid-wins.

A mathematical model was presented of the bidding process that deals explicitly with the uncertainty of the bidders about the value of the subject of the auction. By dealing with this often ignored factor, the model estimated the equilibrium strategies and profits as a function of the number of bidders, the relative values they attach to the subject of the auction and their accuracy in estimating value. Models were developed for highest-bid-wins and lowest-bid-wins auctions. The solutions obtained were strong equilibrium sets of strategies which consider simultaneously the optimality of the decisions of all bidders. This model might have application in the establishment of pricing and allocation policies for future supplies of water. (Kriss-Cornell)
W70-07235

RECENT ADVANCES IN STORAGE AND FLOODING THEORY,
Office of Naval Research, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-07236

A METHOD OF ALLOCATING FUNDS TO INVESTMENT PROJECTS WHEN RETURNS ARE SUBJECT TO UNCERTAINTY,
Smith (A. O.) Corp., Milwaukee, Wis.
Joel Cord.
Management Science, Vol 10, No 2, p 335-341, January 1964. 3 tab, 8 ref.

Descriptors: *Investment, *Dynamic programming, *Risks, *Constraints, *Return (Monetary), Budgeting, Computers.
Identifiers: Uncertainty.

A method was developed for optimally selecting capital investment with uncertain returns, under conditions of limited funds and a constraint in the maxium average variance allowed in the final investment package. A dynamic programming model was developed which considered a single budgeting period and assumed that the net outlays for any selected project took place during that period. The concepts involved in the analysis were somewhat related to Markowitz's work in the portfolio problem. A practical example was given and a computer used to compute the solutions. Clearly water resource projects often involve capital investment and, because of both hydrologic risk and economic uncertainty, have uncertain returns. This method is therefore applicable to such water resource project planning problems. (Kriss-Cornell)
W70-07238

PROBABALISTIC CONSIDERATIONS IN WATER QUALITY MANAGEMENT,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 05G.
W70-07240

A COMPUTER AIDED DECISION SYSTEM,
Polytechnic Inst. of Brooklyn, N.Y.; and Harvard Univ., Cambridge, Mass.
Robert L. Ferguson, and Curtis H. Jones.
Management Science, Vol 15, No 10, p B 550 - B 561, June 1969. 4 fig, 10 ref.

Descriptors: *Computer models, *Computer programs, *Time, *Management, *Decision making, Design.
Identifiers: Subsystems.

A time-sharing computer model was developed and used to conduct experiments in search of operational answers to key questions that arise with the use of on-line, real-time computer based information systems to augment managerial decision making. The research strategy was formulated to investigate these questions from various vantage points. First, a prototype model was selected to explore the structuring problem of designing and programming. The Massuchusetts Institute of Technology's time-sharing computer facility was used and the program was developed and operated in real-time mode. The computer program provided the scheduler with a range of decision choices running from purely manual systems to fully automatic systems which were closed to the possibility of human intervention. Four subsystems were described: the Physical subsystem, the Information subsystem, and the Simulation subsystem, the Decision subsystem, along with a description of the interaction of the total system. The experiments demonstrated that participants, many devoid of computer backgrounds, could make meaningful use of a sophisticated interactive approach to decision making. The model has numerous potential applications to managing water system networks, reservoirs, water and wastewater treatment facilities, and the like. (Kriss-Cornell)
W70-07241

A SAMPLING STUDY OF THE PROPERTIES OF ESTIMATORS TRANSITION PROBABILITIES,
Connecticut Univ., Storrs; Illinois Univ., Urbana; and Morehead State Univ., Ky.
T. C. Lee, G. G. Judge, and R. L. Cain.
Management Science, Vol 15, No 7, p 374-398, March 1969. 10 tab, 59 ref, 1 append.

Descriptors: *Markov processes, *Probability, *Model studies, *Aggegates, *Simulation analysis, Data collections, Time series analysis, Sampling, Population, Least squares method.
Identifiers: Estimators, Parameters.

A sampling experiment was used to evaluate the performance of alternative estimators employed to estimate the transition matrix for a Markov probability model when only the aggregated data, reflecting the proportion of the sample in each state over a sequence of trials, were known. In addition, the experiments provided some initial information relative to the sampling properties of restricted estimators when time series data were used. Simulation and sampling procedures were used to study the sampling properties of the weighted and unweighted general restricted estimators as they relate to estimating the transition properties in the Markov chain from aggregate time series data (e.g. streamflow data). The first order Markov probability model and the simulation model employed was described in detail. The simulation population parameters were presented for the maximum likelihood, unrestricted and restricted least squares, weighted restricted least squares and minimum absolute deviations estimators. The performance of the alternative estimators were evaluated and the general implication of the sampling experiments were discussed. Some applications of the Markov models and potential areas of application were given. Markov models have been used extensively in analyzing stochastic water resource systems, and the determination of transition probabilities from limited hydrologic records is often a problem. This article addresses itself to a means of solving this problem. (Kriss-Cornell)
W70-07242

A CONCEPTUAL FRAMEWORK FOR URBAN PLANNING MODELS,
Harvard Univ., Boston, Mass. Graduate School of Business Administration.
Maurice D. Kilbridge, Robert P. O'Block, and Paul V. Teplitz.
Management Science, Vol 15, No 6, p B246-B266, February 1969. 6 fig, 1 tab, 68 ref.

Descriptors: *Model studies, *Planning, Urban renewal, Economics, Analysis.
Identifiers: Conceptual framework.

A framework for the analysis of models which have been designed for, or used in, urban physical and economic planning (including urban water resources planning) was presented. The models were distinguished by their basic characteristics, rather than on the basis of their applications. Four basic characteristics wereidentified: (1) the subject of the model; (2) its function; (3) its underlying theory; and (4) its method. Besides providing a conceptual framework for the analysis and development of urban planning models, the conceptual framework served as the basis of a classification scheme which allowed the study and comparison of existing models. Such an analysis was presented as an illustration using the conceptual framework. (Kriss-Cornell)
W70-07243

OPTIMAL DEVELOPMENT OF RESOURCES - A PANEL REPORT.
For primary bibliographic entry see Field 06B.
W70-07244

THE DEVELOPMENT OF A MODEL TO EVALUATE HYDROLOGIC RISK IN A WATER RESOURCE SYSTEM,
Battelle Memorial Inst., Richland, Wash.; and Texas A and M Univ., College Station.
For primary bibliographic entry see Field 04A.
W70-07246

PERIODIC MARKOV PROGRAMMING,
Queen's Univ., Kingston (Ontario). Graduate School of Business.
For primary bibliographic entry see Field 04A.
W70-07249

DAILY STREAMFLOW SIMULATION - DISCUSSION OF ARTICLE BY KIP PAYNE, W R NEUMAN, AND K D KERRI,
Illinois State Water Survey, Urbana.
Krishan P. Singh.
Journal of the Hydraulic Division, Proceedings of ASCE, Vol 96, No HY4, p 1046-1047, April 1970. 1 ref.

Descriptors: *Streamflow, *Simulation analysis, *Flow, *Floods, *Time, Water resources.
Identifiers: *Discussion, *Criticism.

The article 'Daily Streamflow Simulation' by Kip Payne, W.R. Neuman, and K.D. Kerri (July 1969) was discussed. (See W69-09355). The authors were commended for their interesting model of a daily streamflow simulator as a new approach to the problem. However, it was felt that some points needed clarification. Criticism was given of the transformation to normal distribution of the rearranged historical flows and the technique for flood flow frequencies. Also questioned was the use to which such a daily streamflow simulator could be put since it seemed that the time sequence of the monthly or seasonal flow peaks will be destroyed and will reduce the accuracy of response. How the simulator can help in analyzing the response of proposed water resource systems was not readily apparent to the author. (Kriss-Cornell)
W70-07250

OPTIMIZATION: THEORY AND PRACTICE,
Heriot-Watt Univ., Edinburg (Scotland).
Gordon S. G. Beveridge, and Robert S. Schechter.
McGraw-Hill Inc, New York, 1970. 773 p, 200 ref, 3 append.

Descriptors: *Optimization, *Analytical techniques, *Numerical analysis, *Variability, *Application methods, Water resources, Planning.
Identifiers: *Techniques, *Practical aspects, Examples, Problems, References.

A presentation that demonstrated the interrelationships between the various facets of optimization was given. The past decade has seen the explosive growth of a class of mathematical methods known as optimization techniques, many of which have found numerous applications in water resources planning. Much of the development has been at a research level, but now attention is being focused on applications and there is a real need for a more general understanding. This need prompted the preparation of this volume which presented a broad but unified coverage of the fundamentals at an introductory level. It intended to serve not only as the background for a formal course, but designed also to facilite self-instruction. The book was divided into three parts: Part One discussed the organization for optimization, the factors influencing the definition of suitable objectives and their subsequent formulation discussed in detail; Part Two presented the techniques of optimization, i.e., the two basic approaches of analytical and numerical optimization were investigated for functions of a single variable, many variables, and an infinite number of variables; and Part Three examined some practical aspects of optimization with particular attention paid to the decomposition of the more complicated systems. A large number of examples were provided throughout the text as an aid to attaining a working proficiency in applying the concepts introduced. The examples were particularly useful for water treatment and wastewater process analyses. Many problems were included with extensive representative references. (Kriss-Cornell)
W70-07251

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
John M. Wilkinson.
Available from the Clearinghouse as PB-192 118, $3.00 in paper copy, $0.65 in microfiche. Final Project Report, May 9, 1970. 334 p, 104 ref, 2 append. OWRR Project C-1415 (1982) (1).

Descriptors: *Water management (Applied), *Water supplies, *Water utilization, *Water pollution, *Surface water, *Groundwater, *Hydrologic data, Floods, Droughts, Multiple purpose reservoirs, Sediments, Irrigation, Navigation, Hydroelectric power, Desalination, Weather modification, Evapo-transpiration, Re-cycle.
Identifiers: *Water-system simulation, *Channel model, *Areal model, *Quality model, *Data system, *Assessment system, Operational functions, Water accounting system.

A data-analytic-reporting system was defined for preparing periodic national water assessments by the Federal Water Resources Council. This system combines all water data input requirements, the analysis of water uses relative to water supply and its quality, and the reporting of this analysis in physical descriptive and predictive terms by operational simulation of water systems for all subregions and river basins, for present and selected future years. Supply analysis incorporates precipitation, evapo-transpiration, surface storage, streamflow, infiltration, and groundwater storage stochastically. Demand analysis incorporates aggregate and point-source withdrawals, consumptive uses, return flows, channel uses, storage uses, inter-basin transfers and re-cycle stochastically. Quality analysis incorporates biochemical oxygen demand, thermal and dissolved-solids effluent loadings in receiving waters, pre- and post-use treatment and instream quality dynamics in stream-segment models. It was designed as a complete assessment system to reveal water excesses and deficiencies and quality problems by use-point, area and over time. The data system was designed to guide organization for simulation. The analytical system defines program routines, subroutines and algorithms in text, charted program logic, and Fortran variables. The rationale for data and model selection is fully documented and output reporting methods are suggested. A critique of prior assessments is provided.
W70-07326

CONJUNCTIVE USE SYSTEMS ANALYSIS,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
J. Day Harold, and M. Shane Richard.
Available from the Clearinghouse as PB-192 116, $3.00 in paper copy, $0.65 in microfiche. Final Report, June 1, 1970. 118 p, 19 tab, 24 fig, 18 ref, 2 append. OWRR Project C-1080 (1577) (1).

Descriptors: *Conjunctive use, *Water utilization, *Storage, *Systems analysis, *Simulation analysis, *Computer models, Surface-groundwater relationships, Optimum development plans, Water storage, Design, Simulation, Costs, Benefits, Recreation, Aesthetics, Water quality, Cities.
Identifiers: *Hybrid simulation models.

Digital simulation and hybrid simulation models have been developed to test alternative plans for the integrated use of surface and sub-surface storage to augment natural streamflow. Techniques for estimating surface storage recreation benefits and aesthetic losses associated with poor water quality in urban riverine areas were developed and used in the ranking of alternatives along with estimates of system costs and reliability. The results of the effort indicate that the full range of possible combinations of surface and sub-surface storage should be considered to insure the selection of the best possible choice.
W70-07328

THE DYNAMICS OF WATER RESOURCES MANAGEMENT IN AN URBAN ENVIRONMENT,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
Douglas L. James.
Typescript, Spring 1970, 10 p.

Descriptors: *Water resources, *Management, *Institutional constraints, *Urbanization, *City planning, Administration, Water supply, Waste water treatment, Cities, Planning, Flexibility, Environment.
Identifiers: *Water resources management, *Urban environment.

The traditional approach to water resources management for urban areas has been based on the examination of needs and the design of separate facilities for water supply, drainage, and waste water collection and treatment. The complexity and interaction among the separate systems required by a metropolitan area has complicated their management and promoted research interest in developing a methodology for better coordination. However, a more thorough evaluation of the problem reveals the real research need to be more complicated and different in character than the problem in systems analysis suggested by the first superficial glance. Water management relates to the much broader problem of community design; when, where, and in what manner should new urban development take place. Furthermore, the character and needs of areas within the metropolis are constantly changing. The key distinctiveness of urban water management is the imperative for design and operation flexibility. The key research need is to develop new designs, operation procedures, and institutional arrangements to make the flexibility demanded by a dynamic urban community possible. (Davis-Chicago)
W70-07509

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCE BY DYNAMIC PROGRAMMING,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 04B.
W70-07555

LEVELS OF OCCUPATIONAL PRESTIGE AND LEISURE ACTIVITY,
Kentucky Univ., Lexington.
Rabel J. Burdge.
Journal of Leisure Research, Vol 1, No 3, p 262-274, Summer 1969. 6 tab, 14 ref.

Descriptors: Social aspects, Income, Age, Education, Statistical methods, Recreation.
Identifiers: *Occupational prestige, Leisure activity, Chi-square test, Social classes, Urban activities, Sports, Hobbies.

Many sociological variables are related to leisure participation. For instance, people in high income brackets, young age categories, high educational levels, generally have been found to be the most active participants in structured leisure activity. Occupational prestige is the variable used in this study to explain differences in the use of leisure. The author contends that the accruement of rewards--monetary and status--determine the variety of leisure outlets. The North-Hatt Occupational Prestige Scale was used as the empirical method of assigning prestige evaluations to specific occupations. The study contends that for almost every type of leisure activity, the probability is that the participants will come from the middle or upper classes. Such an analysis is useful to the water researcher in predicting demand for outdoor water oriented recreation. It is indicative of the importance of including socioeconomic variables in investigating demand for outdoor recreation facilities. (Loeb-Rutgers)
W70-07567

THE THEORY OF LINEAR ECONOMIC MODELS,
Brown Univ., Providence, R.I.; and Rand Corp., Santa Monica, Calif.
David Gale.
New York, McGraw-Hill Book Co, Inc, 1960. 330 p.

Descriptors: *Linear programming, Competition, Equilibrium, Costs, Income, Prices, Leontief models.
Identifiers: *Linear economic models, *Integral linear programming, Two-person game model, Exchange, Duality, Simplex method, Matrix games, Diet problem, Real linear algebra, Scalar product, Matrices, Linear equation, Inequalities, Degeneracy, Saddle point, Minimax, Von Neumann's expanding model.

The term 'economic model' may be thought of as an abstraction and simplification of a typical economic situation. This volume presents several economic models of interest to those concerned with pure and applied mathematics. The first model presented is that of a linear programming model, which in its abstract formulation is a type of mathematical maximum or minimum problem. Many actual economic situations lead to precisely this problem after the appropriate simplifying assumptions have been made. The two-person game model is also discussed. This too is formulated in an abstract manner, but the significance of the model comes from the fact that it is designed to reflect the essential features of certain games of strategy and thus indirectly certain aspects of economic competition. Other models treated concern patterns of exchange between countries or industries, alternative schemes of production and certain economic equilibrium situations. In each case the models are introduced by describing the economic situation, stating the simplifications to be made, and then giving the abstract formulation. Knowledge of the abstract presentation of such models for use in water research should prove to be quite valuable given the extensive use of mathematical and statistical methods in this area. (Loeb-Rutgers)
W70-07570

IMPLICATIONS OF DYNAMIC MONOPOLY BEHAVIOR,
State Univ. of New York, Buffalo.
Frank C. Jen, and Lawrence Southwick, Jr.
American Economic Review, Vol 59, No 1, p 149-158, March 1969. 10 p, 13 ref.

Descriptors: *Monopoly, Demand, Model studies, Industrial production, Prices, Marginal costs, Costs.
Identifiers: *Dynamic monopoly behavior, *Dynamic models, *Natural monopoly, Duopoly, Strategy, Oligopolistic behavior, Cost curves, Demand curves, Dynamic duopoly model, Imposed monopoly, Collusion, Entry.

The behavior of a monopolist has traditionally been studied via static models allowing only one seller to operate. The authors suggest that a convenient way to study dynamic monopoly behavior is to construct a general dynamic duopoly model from which conditions for various types of monopoly can be derived. This paper constructs such a model and derives the 'maximizing' equation. Section II derives the conditions under which a natural monopoly can exist. The possible production and price paths of a monopoly are discussed. Section III studies the production and pricing strategies of a firm which has a monopoly protection initially and wants to continue the monopoly. Section IV compares the effects of collusion with those of monopoly and studies the implications of this model with respect to oligopolistic behavior. A review of the findings and a discussion of areas for further research is found in Section V. Many water producers in control of a water supply find themselves in a position similar to that of a natural monopolist. As such, this paper may assist understanding of the productive and pricing strategies of such agencies. (Loeb-Rutgers)
W70-07571

LOW FREQUENCY VARIATION IN ECONOMIC TIME SERIES,
Osaka Univ. (Japan); and Pennsylvanis Univ., Philadelphia.
Hatanaka Michio, and Howrey E. Philip.
Kyklos, Vol XXII, No 4, p 752-766, 1969. 15 p, 2 tab, 9 fig, 16 ref.

Descriptors: *Time series analysis, *Statistics, *Economics, Mathematical studies, Gross National Produce, Estimating frequency analysis, Investment.
Identifiers: *Econometrics, *Spectrum-analysis, Statistical significance, Cyclical data, Business cycle, Trend analysis.

A number of investigators have suggested that many economic time series exhibit significant long-run variations about an upward trend as well as short-run business fluctuations. The purpose of this paper is to point out that the conclusion reached in a number of studies, using spectrum-analytic techniques, made to test the theory that long-run variations contribute substantially to the variance of economic time series are false in their findings of a lack of significance for the long-run variations. This paper suggests that while there is some evidence of long swings in economic activity, the problems inherent in the analysis of low-frequency variation made it extremely difficult to ascertain their statistical significance. The use of time series data in the economics of water resource planning makes this article of general interest to the empirical water researcher. (Murphy-Rutgers)
W70-07572

A NOTE ON ESTIMATION OF COBB-DOUGLAS AND CES PRODUCTION FUNCTION MODELS,
Wisconsin Univ., Madison.
Dorothy J. Hodges.
Econometrica, Vol 37, No 4, p 721-725, October 1969. 3 ref.

Descriptors: Estimating, Profit, Competition, Least squares method.
Identifiers: *Estimation, *CES Production Function, Cobb-Douglas Production Function.

Zellner, Kmenta, and Dreze in a recent article specified a Cobb-Douglas production model in which the traditional profit maximization assumption was modified to explicitly recognize the stochastic nature of profits. Assuming that firms maximize the mathematical expectation of profits, the authors found that under conditions of pure competition least square estimation of the production function from cross section data on firms' output and inputs provides consistent estimates of the production function parameters if certain reasonable specifying assumptions are satisfied. The purpose of this note is to point out that use of the Zellner, Kmenta, and Dreze framework with a CES production function will also result in a model which permits consistent estimation of the production function parameters from single equation estimation of the production function relation itself. Section 1 of the note demonstrates this conclusion. Section 2 provides the specification and estimation of a related model for a firm operating as a pure monopolist. This article will be applicable in the water area to estimate water production functions in a CES specification. (Loeb-Rutgers)
W70-07573

ADDITIVE VON NEUMANN-MORGENSTERN UTILITY FUNCTIONS,
Pennsylvania Univ., Philadelphia.
Robert A. Pollak.
Econometrica, Vol 35, No 3-4, p 485-494, July-October 1967. 10 p.

Descriptors: Economics.
Identifiers: *Additive utility function, von Neumann-Morgenstern utility, Ordinal utility function, Strong additive axiom, Weak additive axiom, Log additive.

The von Neumann and Morgenstern utility function is one which ranks situations involving probabilities and as such looks at the problem of risk. Necessary and sufficient conditions for the additivity of ordinal utility functions are well known. In this paper a necessary and sufficient condition for the additivity of von Neumann-Morgenstern utility functions is presented; this condition is summarized in the 'strong additivity axiom.' A 'weak additivity axiom' is introduced, and it is shown that an individual's preferences satisfy this axiom if and only if his von Neumann-Morgenstern utility function is either additive or 'log additive.' The extension of these results to the continuous consumption case is indicated. This article might offer theoretical applications to the water researcher interested in resources allocation and demand behavior under risk. (Author)
W70-07574

AN EXTENSION OF THE NET PRESENT VALUE CONCEPT OF INTERTEMPORAL INVESTMENTS,
Texas Univ., Austin.
William G. Lesso.
The Engineering Economist Vol 15, No 1, p 1-8, Fall 1969.

Descriptors: *Economic evaluation, *Rate of discount, *Benefits, *Costs, *Project planning, Project life, Demand, Investment, Mathematical studies, Risk, Budgeting, Capital.
Identifiers: *Net present value, *Monotonicity, Inflation.

In evaluating investment alternatives which have returns or benefits in future time periods, the method usually used is to determine the net present value of the required investment and future returns, taking cognizance of the time value of money. The usual case is where investments occur in the current time period. This article discusses two important variations where: (1) the required investment may span several time periods; and (2) it may be necessary to consider alternatives which will occur in future time periods. Both of these situations are likely to arise in water resource projects. The author extends the net present value criterion to cover these situations and also shows that it is possible to determine the montonicity of alternatives with constant returns. The net present value concept is thus adopted to a larger class of problems. The widespread use of this concept in the area of water resources makes this article of interest to the water planner. (Murphy-Rutgers)
W70-07575

SALES MAXIMIZATION AND MANAGERIAL EFFORT: NOTE,
State Univ. of New York, Buffalo.
David J. Smyth.
American Economic Review, Vol LIX, No 4, p 633-634, September 1969. 1 fig, 3 ref.

Descriptors: Elasticity of demand, Demand, Profit, Income.
Identifiers: *Sales maximization, *Managerial effort, Firm size, Effort, Output.

This note modifies Baumol's familiar sales maximization model by introducing the assumption that managers trade off the advantages of the increased firm size with the disadvantages of the increased effort involved. With this assumption, equilibrium output occurs with the elasticity of demand greater than unity and accordingly the sales maximization hypothesis cannot be refuted by the observation of an elastic demand with above minimum profits earned. This may prove useful in the water area where, for example, with the assumption made above, sales (visits) maximization is the goal for a manager in charge of an outdoor recreation facility. (Loeb-Rutgers)
W70-07576

SOME STOCHASTIC ASPECTS OF SHIP DESIGN ECONOMICS,
Michigan Univ., Ann Arbor.
Odo Krappinger.
The Engineering Economist, Vol 12, No 3, p 167-181, Spring 1967. 4 fig, 2 ref.

Descriptors: *Risks, Ships, Stochastic processes, Economics, Costs, Income, Probability, Time, Interest rate.
Identifiers: *Stochastic aspects, *Ship design, Design alternatives, Present worth, Freight rate.

Engineering Economy has been described as something of a universal solvent, allowing the engineer to weigh the relative merits of design alter-

natives involving different units. Conversion of the features of design alternatives to costs is in many cases a sufficient tool for this purpose. But there are also situations in which a knowledge of costs alone is not enough to make a rational decision. For example, innovations often bear risks and uncertainties. If an engineer wants to demonstrate to the business manager the economic feasibility of an unconventional design, a description of the involved risks and uncertainties is at least as important as the cost information. Future costs and revenues can seldom be predicted exactly. This does not matter if their expected scatter is small, but when the scatter is relatively large, neglecting the influence of the involved risk and uncertainty may lead to wrong decisions. The author assumes that the reader is familiar with two suggested references on ship design and the fundamentals of probability theory. This study is limited to the investigation of annual compounding and may prove useful in the water area where risks and uncertainity must be accounted for in investment and planning decisions. (Loeb-Rutgers)
W70-07577

RESHAPING GOVERNMENT IN METROPOLITAN AREAS.

New York Committee for Economic Development, February 1970. 83 p.

Descriptors: *Federal government, *State government, *Local government, *Economics, *Government supports, Government finance, Transportation, Water supply, Water pollution, Taxes, Education, Sewage.
Identifiers: *Governmental centralization, *Metropolitan government, Job training, Welfare, Poverty.

This report studies the problem of reshaping urban governments for the purpose of solving some of the problems now faced by most metropolitan areas. Of particular interest to the water researcher is its examination of the relationship between the structure of government and the problems of water supply and water pollution. The economics of financing solutions to metropolitan problems of education, transportation, housing, welfare water pollution and water supply are investigated. The interrelationships between the local, state and federal governments with respect to their tax and revenue structure and present aid systems are analyzed and recommendations are offered. The report calls for a restructuring of metropolitan governments with area-wide institutions for some functions of government while maintaining units of government compact enough to enable the recipients of government services to have some control over their quality and quantity. (Murphy-Rutgers)
W70-07579

6B. Evaluation Process

WATER-RESOURCES MANPOWER–SUPPLY AND DEMAND PATTERNS TO 1980.
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 09A.
W70-07229

OPTIMAL DEVELOPMENT OF RESOURCES - A PANEL REPORT.

Journal of the Power Division, Proceedings of ASCE,Vol 96, No PO1, Proc Paper 7073, p 205-210, February 1970.

Descriptors: *Optimization, *Planning, *Decision making, *Water resources development, *Technology.

The objective of the Panel was to explore the opportunities for optimal planning and operation in the power field as associated with multi-resource, multipurpose planning of the physical elements involved. Among the elements included was water (as well as energy, air and land). With the view of resource use, a consideration of the question of optimal use was divided into three areas. The first, concerned with questions relating to the goals and objectives of resources development, was regarded as an analysis of the highest level of a hierarchy of decisions and included socio-economic issues. The second concerned the decision making process itself so that truly optimal decisions can be reached in the complex situations which characterize practical applications. The third level concerned the technical problems that need solution so that optimal decisions can be reached. Specialized problems noted, which were related to water resources were: environmental changes produced by power development, water quality parameters along a river, reservoir operating policies, flood control capability of a reservoir, and problems associated with fluctuation in river flow rates and reservoir levels. (Kriss-Cornell)
W70-07244

POTENTIAL FOR POLICY CHANGE IN THE RECREATIONAL USE OF DOMESTIC WATER SUPPLY RESERVOIRS,
Southern Illinois Univ., Carbondale, Ill. Dept. of Geography.
Duane D. Baumann.
In: Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), ed. Phillip Cohen, Martha N. Francisco, p 559-569, 3 fig, 28 ref.

Descriptors: *Multiple-purpose reservoirs, *Water quality, *Water treatment, *Viruses, *Bacteria, *Chlorination, Filtration, Flocculation, Sedimentation, Northeast U.S., Texas, Kansas, Illinois, Massachusetts.
Identifiers: *Cognitive dissonance, *Policy change, *Water managers, England, Soviet Union, Far West U.S.

Recreational use of reservoirs is described and analyzed and means of bringing about policy changes outlined. Using available data, it was found that 32 per cent of the communities prohibited all forms of reservoir recreation. Restrictions were heavier in the Northeast and Far West where 61 per cent restricted all recreation; in the remainder of the country, this figure was only 8 per cent. Interviews with 26 water managers in Texas, Kansas, Illinois, and Massachusetts most frequently indicated fear of an increased health hazard and possible deterioration in the quality of drinking water. Studies which have sought to determine the extent of water pollution attributable to recreational activities have concluded either: (1) that recreational activities produce no significant pollution, (2) that recreational activities are a major source of pollution, (3) or that only certain kinds of activities can contribute markedly to the pollution load. Critical review of these studies is given concluding that all forms of recreation can be permitted without increasing risk of water-borne disease. The author argues that chlorination is able to destroy virus if filtration to break down particulate organic matter is practiced. Using Festinger's theory of cognitive dissonance, the author outlines three means by which water managers attempt to reduce dissonance. He concludes that if the demand for water-oriented recreation becomes great enough, water managers will change their cognitions. (Preckwinkle-Chicago)
W70-07287

THE ANALYSIS AND EVALUATION OF PUBLIC EXPENDITURES: THE PPB SYSTEM.
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.

Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., 3 Vol., 1241 p., 1969.

Descriptors: *Economics, *Administration, *Cost analysis, *Decision making, *Government finance, *Resource allocation, Planning, Institutions, Economic feasibility, Benefits, Cost benefit analysis, Planning, Budgeting.
Identifiers: *PPB system, Financial management, Programming, Public expenditures policy.

A compendium of papers in three volumes relative to the PPB system (Planning, Programming, Budgeting system) of the Federal government. Volume I, which is by far the most relevant to water resources, covers the appropriate functions of government in an enterprise system, the institutional aspects affecting efficient public expenditure policy, and some problems of analysis in evaluating public expenditure alternatives. Papers are included by various well known economists from educational institutions as well as agency representatives. Issues covered include many which are of basic importance to water resources, such as externalities, uncertainty, publicly administered prices, income distribution, problems of incentives, constraints, discount rates, multiple objectives and regional impacts. Volume II covers the current status of the PPB system, and Volume III covers the performance of the PPB system, in certain areas and a summary of unresolved issues. The latter two volumes are of less economic importance to water resources mainly because the economic analysis of water resources projects is far more advanced than that of the majority of governmental programs; so that the PPB system utilizes economic analysis rather than creating it. (See also W70-07289 thru W70-07307) (Whipple-Rutgers)
W70-07288

EXTERNALITIES, INFORMATION AND ALTERNATIVE COLLECTIVE ACTION,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
Otto A. Davis, and M. I. Kamien.
The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol. 1, p 67-86, 1969.

Descriptors: *Third party effects, *Economics, *Water pollution, Cost benefit analysis, Resource allocation, Indirect benefits, Economic efficiency.
Identifiers: *Externalities.

One of the reasons why an unfettered market system may fail to serve the public interest is the inability of the market to take into account certain kinds of side effects or externalities. Another reason is the deficiency in quality and quantity of information. The paper deals mainly with the externalities problem. The problem of air and water pollution are employed to illustrate the market failure entailed by side effects or externalities. The ability of a river to assimilate waste is recognized as a natural resource, which should be used. In the case of externalities, the authors point out that a number of means of collective action are available, each of which has its own disadvantages. The methods discussed include solution by prohibition, by directive, by voluntary action, by taxes and subsidies, by regulation, by payment and by direct public action. Some form of cost-benefit analysis is suggested to determine which is applicable in a given situation. (See also W70-07288) (Whipple-Rutgers)
W70-07289

CONSTRAINTS ON POLICY ANALYSIS AND POLICY IMPLEMENTATION IN THE FEDERAL AGENCIES,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
Asher Achinstein.
The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol. 1, p 369-415, 1969.

Descriptors: *Economics, *Constraints, *Federal government, Benefit cost analysis, Legislation, Administration, Transportation, Appropriation, Management.
Identifiers: Program evaluation.

This paper summarizes and provides a critique of views of 20 Federal agencies as to the extent to which the agency use of economic analysis in policy formation and decision is impeded by constraints. The agency replies are given as an appendix. The paper discusses institutional, budgetary, personnel, financing, methodological and statutory constraints. Constraints clearly applicable to water resources programs include the following: (a) reluctance of an agency to study in detail alternatives not currently authorized as a Federal program of that agency, (b) relative difficulty in conducting inter-agency analysis where there is a mutual interest between departments, or between levels of government, (c) high cost of planning, and rigidities and delays in the appropritations process, (d) difficulties of making cost benefit analysis in certain fields. One statutory constraint, namely, a legislative enactment requiring a method of benefit analysis of water transportation improvements which is basically uneconomic. (See also W70-07288) (Whipple-Rutgers)
W70-07290

ON THE DISCOUNT RATE FOR PUBLIC PROJECTS,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
William J. Baumol.
The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol. 1, p 489-503, 1969.

Descriptors: *Economic efficiency, Economics, *Benefit cost analysis, *Interest, *Discount rate, Risks, Program evaluation.
Identifiers: *Opportunity costs, Uncertainty.

After a brief analysis the author states that the correct discount rate for the evaluation of a government project is the percentage rate of return that the resources utilized would otherwise provide in the private sector. However, resources withdrawn from a corporation usually have a higher opportunity cost than those drawn from direct consumer use. Reasons for diversions between industries include taxes, risk and externalities. As regards taxes, government discount rate should be weighted average of opportunity costs from sectors having different tax impacts. Extra returns on account of risk should not be included in opportunity costs; because, although losses are serious to the individual, the loss to society as a whole is determined by averages and may be less. The argument for an arbitrarily low discount on government projects in order to increase society's investment for the future is tenuous at best and should not be accepted. The author indicates that the weighted discount rate outlined lies in the regions of the second best. 'Society could obviously benefit by a transfer of capital from areas in which its social return is relatively low to other parts of the economy offering a higher social return.' However, the paper does not pursue this conclusion into specifics regarding sources of government revenue, and instead points out that there may be externalities not included in differing rates of return. Certain difficulties in actually deriving a social discount from the formula given are pointed out. (See also W70-07288) (Whipple-Rutgers)
W70-07291

THE ROLE OF SOCIAL INDICATORS AND SOCIAL REPORTING IN PUBLIC EXPENDITURE DECISIONS,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
Isabel V. Sawhill.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol 1, p 473-85, 1969.

Descriptors: *Social aspects, *Economics, *Program evaluation, Benefit cost analysis, Environmental effects, Decision making.
Identifiers: *Social indicators, *Distributional effects, Quality of the environment.

A social indicator is a proxy measure of welfare. Because outputs of so many public expenditures include improvements in some aspect of the quality of life, public decision makers and analysts require some procedures for evaluating or measuring changes in these social characteristics. Recent efforts by the Department of Health, Education and Welfare to develop a set of social indicators are described in this paper, both as to methodology and actualprogress. Aspects of life to be measured include social mobility (correlation between occupational status of father and son), health, physical environment, income and poverty, public order and security, and learning science and art. The author suggests formation of a Council of Social Advisers to establish a link between social indicators and more effective public expenditure. The above considerations apply to effects of water resources programs as well as other programs. (See also W70-07288) (Rutgers-Whipple)
W70-07292

THE ORGANIZATION OF ECONOMIC ACTIVITY: ISSUES PERTINENT TO THE CHOICE OF MARKET VERSUS NONMARKET ALLOCATION,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Kenneth J. Arrow.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 47-64, 1969.

Descriptors: *Economics, *Competition, *Economic efficiency, Third party effects, Cost benefit analysis.
Identifiers: *Externalities, *Price mechanism, Public goods.

While the price mechanism of the private sector is an efficient resource allocating mechanism under many conditions, it fails to function appropriately when certain other conditions prevail. The paper deals mainly with conditions under which the private competitive market system fails to lead to an efficient allocation of resources. Concepts of public goods, externalities, increasing returns, lack of information, and transaction costs are presented as relevant to the market versus nonmarket allocation debate. Such issues are relevant to the economics of water resources. The discussion is relevant to policy questions regarding charging for certain water resources outputs. (See also W70-07288). (Whipple-Rutgers)
W70-07293

PROJECT DESIGN AND EVALUATION WITH MULTIPLE OBJECTIVES,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
A. Myron Freeman, III.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 565-578, 1969.

Descriptors: *Intangible benefits, *Economics, *Economic justification, *Social aspects, *Benefit cost analysis, Benefits, Program evaluation, Economic efficiency.
Identifiers: *Income redistribution, *Multiple objectives, *Non market values, Shadow prices, Public goods.

The problem of choosing between alternative public sector investments is complicated by the fact that the benefits of all programs are not commensurate, since some of them have not been possible to evaluate in money terms. In such cases, the efficiency criterion is not adequate for project evaluation; and even where benefits are evaluable, income redistribution effects remain for consideration. The problem cannot really be avoided, since choices must be made. The first approach which has been proposed to this problem is to evaluate for each alternative the project costs and all tangible benefits, in dollar terms, and then to list the unvalued benefits. This leaves the decision maker to select an alternative based upon his implicit judgment of values. The second approach is to establish some minimum acceptable value for one benefit, and then 'to maximize the other benefit subject to meeting the constraint'. In place of either of the above approaches, the author favors a 'conscious, deliberate selection of weights by decision makers', which in effect would constitute a social welfare function. The author feels that in at least one case, namely income redistribution, it may be possible to infer weightings from legislative enactments of the past. From a practical viewpoint, it seems that useful initiatives of this nature are most likely to come from the Federal executive agencies. Such considerations are applicable to water resources programs. (See also W70-07288). (Whipple-Rutgers)
W70-07294

THE ABSENCE OF KNOWLEDGE OF DISTRIBUTIONAL IMPACTS: AN OBSTACLE TO EFFECTIVE PUBLIC PROGRAM ANALYSIS AND DECISIONS,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
James T. Bonnen.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 419-449, 1969.

Descriptors: *Economics, *Program evaluation, Constraints, Benefit cost analysis.
Identifiers: *Equity, *Distributional effects, Income distribution, Regional income distribution.

Distributional effects constitute an equity issue to which increasing attention is being given, but there is little data for analysis of the issue. Measurement of impacts by region would be desirable, as well as by income, age, sex, family status, degree of urbanization and race of the persons benefitted. Some Federal programs which were created for equity reasons may have perverse distributional consequences. Concerning water resources programs, the author cites recent analyses showing (1) adverse regional distributional consequences of irrigated cotton developments in the west, and (2) favorable distributional consequences of certain Corps of Engineers projects in the south. Much more data is available regarding certain agricultural programs. The author concludes that strong efforts should be made to obtain data and to evaluate distributional consequences of programs. The paper does not define the concepts involved or discuss the relationship between the distributional aspects of benefits and those of taxation. (See also W70-07288). (Whipple-Rutgers)
W70-07296

THE TREATMENT OF RISK AND UNCERTAINTY,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Jack Hirshleifer, and David L. Shapiro.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 505-530, 1969.

Descriptors: *Economics, *Economic efficiency, *Interest, *Discount rate, *Risks, Benefit cost analysis, Program evaluation.
Identifiers: Opportunity costs, Time-state preference, Uncertainty.

There is very little understanding of how the government should adjust to the existence of risk and uncertainty when evaluating alternative public undertakings. Existing Federal practice has been extremely disparate, reflecting the confused state of economic thought on the matter. This paper mainly concerns the discount rate to be used in Federal investment. The authors review the basic propositions on which the economic analysis of public investment rests and discuss meanings attached to 'risk' and 'uncertainty'. One of the key unsolved problems in the literature is that some writers see premiums paid for risk aversion to be a social cost, whereas others argue that such premiums are not socially relevant. In part, the controversy surrounding the appropriate discount rate has resolved about this point. The authors discuss some recent developments of theory, and particularly a model of 'time-state preference', which is viewed as a framework for public sector response to the problems of risk and uncertainty. This model leads to the conclusion that the application of a riskless rate of interest in discounting is inappropriate, and that the 'rule of large numbers' sometimes relied upon to support a disregard for such risks cannot be supported. The authors consider briefly the existence of corporate income tax, which is viewed as an obstacle to optimum investment in risky programs, such that any discount rate chosen for Federal use will lie in the realm of the second best. The questions discussed apply to water resource functions, especially as concerns discount rate used. (See also W70-07288). (Whipple-Rutgers)
W70-07297

UNCERTAINTY AND THE NEED FOR COLLECTIVE ACTION,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Richard Zeckhauser.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 149-166, 1969.

Descriptors: *Risks, Economic efficiency, Economic justification.
Identifiers: *Uncertainty, *Risk aversion, Collective action, Continguent claims markets.

The existence of uncertainty, a lack of knowledge of which state of nature will obtain in the future, may prevent the achievement of optimal results from the free market system. Contingent claims markets, such as insurance systems, are commonly adopted to improve results from the individual's viewpoint. Although transaction costs are not negligible, and the customer may pay more than the actuarial value of the risk prevented, his utility may still be increased if he is a risk averter, as regards his utility function of wealth. Contingent claims markets do not exist in certain fields, and many are unsatisfactory due to deficiency in information. Efficient provision of such goods and services must take into account risk-spreading considerations and utilities in anticipation of use. Institutions available may affect the decision as to whether the goods should be provided and if so by the government unit. The collective provision of goods raises questions of equity if some individuals benefit at the expense of others. The above considerations apply to uncertainty in water resources analysis. (See also W70-07288). (Whipple-Rutgers)
W70-07298

BUDGET 'UNCONTROLLABILITY' AS AN OBSTACLE TO IMPROVING THE ALLOCATION OF GOVERNMENT RESOURCES,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Murray L. Weidenbaum.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 357-368, 1969.

Descriptors: *Economics, *Constraints, *Benefit cost analysis, Decision making, Appropriation, Budgeting.
Identifiers: *Program evaluation, Public expenditure analysis.

Economic analysis can only improve Federal expenditure policy if the analysis can be implemented. Currently a substantial share of the Federal budget cannot be transferred from one program to another by the budget review and appropriation process. Examples are trust funds, permanent and indefinite appropriations fixed charges, and ongoing projects. The author finds that only 52% of the Federal budget is relatively controllable. Under present law it appears futile to perform benefit-cost analysis to demonstrate a higher return obtainable from one program rather than another. It is recommended to reduce the institutional obstacles to the implementation of sound public policy. Water resources presumably would be compared economically to other Federal programs, provided procedures of inter-program analysis suggested in this paper were actually relied upon. (See also W70-07288). (Whipple-Rutgers)
W70-07299

EFFICIENCY GOALS, MARKET FAILURE AND THE SUBSTITUTION OF PUBLIC FOR PRIVATE ACTION,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
John V. Krutilla.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 277-289, 1969.

Descriptors: *Economics, *Resource allocation, *Economic efficiency, *Third party effects, Cost benefit analysis, Decsion making, Interest rates.
Identifiers: *Externalities, Public goods, Price mechanism, Market failure.

This paper considers whether public investments which are undertaken to improve the allocative efficiency of the market necessarily attain that objective. While the failure of the market to reflect social worth of certain outputs and inputs may make public intervention necessary, the result may not be economically efficient. Among the obstacles are cited biases in the application if investment criteria, constraints within the government on replacing traditional policies with more relevant alternatives, and pricing polcies for publicly produced goods. The traditional separation of analysis of economic benefit from questions of reimbursement is conducive to pricing below marginal costs, which in turn may lead to over investment by the government and over consumption in the private sector. A concerted effort should be made to improve government decision-making procedures and pricing policies. These considerations apply to the pricing of water resources outputs. (See also W70-07288). (Whipple-Rutgers)
W70-07300

SHADOW PRICES FOR INCORRECT OR NONEXISTENT MARKET VALUES,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Julius Margolis.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 533-546, 1969.

Descriptors: *Economics, *Economic efficiency, Benefit cost analysis, Market values, Program evaluation.
Identifiers: *Shadow prices, Nonmarket values, Opportunity costs.

In evaluating benefits and costs of various proposals, it is essential to have values assigned in the absence of acceptable market values. This is a frequent case, since government activity is frequently directed towards those activities for which there is no market (including most activities of Federal Water resources). It is the duty of the economist to develop values for outputs and inputs which correspond to those which would have been established by a competitive market if one had existed. Such values are known as shadow prices. The determination of shadow prices is difficult because there is no widespread agreement on the basis for generating social values. The economist should try to aggregate the preferences of people in the society, rather than relying on the preferences of program planners or administrators. The author considers that the willingness of people to pay for government outputs is a measure of social value. However, it is often difficult to estimate willingness to pay; and there are legal and institutional restraints which may lead to errors. The author considers that unless decision makers act on the basis of such prices, little is gained. (See also W70-07288). (Whipple-Rutgers)
W70-07301

EVALUATING PUBLIC EXPENDITURES UNDER CONDITIONS OF UNEMPLOYMENT,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Robert H. Haveman.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 547-561, 1969.

Descriptors: *Economics, *Economic efficiency, *Benefit cost analysis, *Unemployment, Costs, Economic justification.
Identifiers: *Unemployed resources, *Social costs, Non-market values, Opportunity costs.

Public investments may be undertaken under conditions of less than full employment, and, in such a case, resources used which would otherwise be unemployed are valued at a social cost less than the monetary cost, since these resources by definition would not otherwise be producing anything else. Such a divergence between social costs and monetary costs can be observed even under conditions of low over-all unemployment, because of substantial differences of unemployment rates by occupation, by industry, and by region. Using a recently developed computational model, it is explained how the true social cost of a public expenditure can be estimated, by adjusting monetary costs for idle resource use. Through such adjustments, projects with otherwise unacceptable benefit cost ratios may be shown to have social benefits in excess of social costs. Such analyses are presumably applicable to water resources investments as well as other forms of public expenditure. (See also W70-07288). (Whipple-Rutgers)
W70-07302

BENEFICIARY CHARGES AND EFFICIENT PUBLIC DECISIONS,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Jerome W. Milliman.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 291-318, 1969.

Descriptors: *Economics, *Economic efficiency, Resource allocation decision making, Prices, Financing.
Identifiers: *Marginal-cost pricing, *User charges, *Beneficiary charges, Public goods, Price mechanism, Private goods, Equity.

Most observers of public expenditure policy consider that much wider use should be made of user charges (beneficiary charges). However, the literature mingles questions of efficiency, equity and financing, and often treats alike questions involving the scale of new investments and those involving the use of existing facilities. As regards short-run efficiency, or the management and pricing of outputs from a government project, the author sees the

need for further work on both theory and practice. The welledeveloped marginal-cost pricing literature provides one of the determinants for pricing policy, but considerations of cost-recovery and other aspects may also be valid considerations. The imposition of beneficiary charges for public services appear generally desirable, but problems arise in implementation, particularly for services which are of the nature of public goods. The whole question requires much more study. The discussion is relevant to actual and proposed user charges for several water resources outputs. (See also W70-07288). (Whipple-Rutgers)
W70-07304

PERVASIVE ESTERNAL COSTS AND THE RESPONSE OF SOCIETY,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Allen V. Kneese, and Ralph C. d'Arge.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 87-115, 1969.

Descriptors: *Third party effects, *Economics, *Water pollution, *Environmental effects, Resource allocation, Economic efficiency, Wastes.
Identifiers: *Externalities, Waste residuals.

Extensive air and water pollution, urban congestion, landscape deterioration and other environmental aspects of economic growth indicate that externalities and spillovers are pervasive phenomena in our society. These effects are present in most of both production and consumption processes in our economy. The waste residuals to be disposed of in the environment are shown to be approximately equal in tonnage to that of the basic materials utilized by the economy. Such widespread conditions cannot be viewed as anomalies in an otherwise smoothly-functioning market system. The authors argue that most of the formal approaches of economists are of limited usefulness for this reason. In particular, the assumed independence of production and of utility functions in basic economic models becomes less defensible. To analyze such pervasive systems of externalities, the authors outline a more comprehensive economic model, designed to assist decision makers in developing a more effective collective response to pollution-type problems. Environmental controls should be devised such that decentralized voluntary exchanges can again be relied upon to approximate optimal results. (See also W70-07288). (Whipple-Rutgers)
W70-07305

THE PUBLIC SECTOR AND THE PUBLIC INTEREST,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Peter O. Steiner.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 13-46, 1969.

Descriptors: *Social aspects, *Decision making, *Economics, *Economic efficiency, Public benefits, Benefits, Cost benefit analysis.
Identifiers: *Objective function, Public good, Public interest, Social welfare function, Income redistribution.

What should be the appropriate role of the public sector in a society in which most goods and services are provided in a market system based upon individual choices. The economist's definition of public goods is criticized and the reasons for reserving certain activities to the public sector are classified. The concept of public interest is discussed. Difficulties of establishing a single objective function are ennumerated, the author preferring an aggregate social welfare function, based upon revealed social priorities. An argument is given that a single discount rate should not be used, since this implies a lexicographic ordering of objectives. Multiple objective functions cannot well be applied either by assuming one function dominant or by assuming a quantitative relationship between objective functions, which may be erroneous. The author does not favor an efficiency approach, which he regards as implying one of two alternative views: (a) any worthy objective can be included in an efficiency approach by giving it a quantitative value, (b) objectives such as income redistribution should not be included, but should be satisfied by taxes or allocations specifically for that purpose. The above discussion covers points of basic importance to water resources. (See also W70-07288). (Whipple-Rutgers)
W70-07306

SYSTEMATIC ANALYSIS AND GRANTS-IN-AID IN A FEDERAL SYSTEM,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Selma Mushkin, and John Cotton.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printin Office, Washington, D.C., Vol I, p 332-354, 1969.

Descriptors: *Administration, *Management, Operations research, Federal government, State government grants, Economics.
Identifiers: *PPB system, *Grant-in-aid, *Program evaluation, *Public expenditure analysis.

This paper examines the effect of public expenditure analysis upon Federal grant-in-aid programs, especially the shift of emphasis, through the PPB system, from program inputs to program outputs. There appears to be a need for equivalents of the Federal PPB system in state and community governments. The authors consider that the PPB system can aid the Federal government in developing effective incentives and local governments in developing and operating efficient programs. Federal grants now often require program evaluation, systems analysis, and cost effectiveness measurement. Experimental projects should be developed to further develop the methodology and data necessary for program evaluation. The discussion is relevant to the Federal grant-in-aid programs in the water pollution control field. (See also W70-07288). (Whipple-Rutgers)
W70-07307

EVALUATION OF NATURAL RIVERS,
Antioch Coll., Yellow Springs, Ohio.
Morisawa Marie, and Murie Martin.
Available from the Clearinghouse as PB-192 115, $3.00 in paper copy, $0.65 in microfiche. Final Report, (1970). 143 p, 31 tab, 48 fig, 6 plates, 9 ref, 3 append. OWRR Project C-1314 (1966).

Descriptors: *Evaluation, River flow, Water budget, *River basins, *Rivers, *Environment, History, Aesthetics, *Hydrologic data, Surveys, Hydrologic aspects, Data collections, Plants, Aninads, Geologic formations, Geomophology.

The Little Miami in Ohio and the Green in Wyoming were studied to develop methods of gathering quantitative data and using it to evaluate the hydrologic, geologic, biologic aesthetic, and cultural aspects of rivers. Field data on fauna, flora, geology, hydrology, history, and aesthetics were gathered at stations along the river valleys, and classification schemes were proposed.
W70-07327

ECONOMIC VALUES OF IRRIGATION WATER IN FOUR AREAS ALONG THE SNAKE RIVER IN IDAHO.
Idaho Agricultural Experiment Station, Moscow.
For primary bibliographic entry see Field 03F.
W70-07334

CALIFORNIA UNDERSEA AQUEDUCT PRERECONNAISSANCE STUDY.
Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Sacramento, Calif.
For primary bibliographic entry see Field 08A.
W70-07423

BENEFIT-COST ANALYSIS AND THE NATIONAL OCEANOGRAPHIC PROGRAM,
Washington Univ., Seattle. Dept. of Economics.
James A. Crutchfield, Robert W. Kates, and W. R. Derrick Sewell.
Natural Resources Journal, Vol 7, p 361-375, July 1967. 16 ref.

Descriptors: *Cost-benefit analysis, *Economic efficiency, Oceanography.
Identifiers: National Research Council, National Academy of Sciences.

The monograph entitled, Economic Benefits from Oceanographic Research, published by the National Research Council of the National Academy of Sciences (1964), is examined. The basic problems of establishing the appropriate level of oceanographic research and its proper allocation among constituent elements of the program are not resolved by the benefit-cost analysis undertaken in the NAS STUDY. The very process of benefit-cost analysis forces the agencies concerned to isolate and examine the outputs and associated costs resulting from their activities, and may lead to an internal reordering of programs in the direction of greater efficiency. Also, benefit-cost analysis provides a basis for rational choice between programs. A danger of requiring benefit-cost analysis to receive funds from the Bureau of the Budget is that agency planning may be warped in the direction of mission-oriented research as opposed to basic research, and toward applied programs that are less risky. (Grossman-Rutgers)
W70-07529

THE IMPACT OF RESERVOIR RECREATION ON THE WHITNEY POINT MICROREGION OF NEW YORK STATE,
Cornell Univ., Ithaca, N. Y. Dept. of Agricultural Economics.
Robert Charles Hinnan.
A.E. Res. 295, Cornell University Water Resources and Marine Sciences Center, Technical Report No. 18, Aug, 1969. 73 p, 3 fig, 24 tab, 42 ref.

Descriptors: *Recreation, *Economic impact, *Input-output analysis.
Identifiers: *Use survey, *Whitney Point Reservoir Recreation Area.

The setting background and development of the Whitney Point Reservoir Recreation Area are discussed. The study estimates the economic impact of the autonomous investment in developing the area, as well as the impact of the outside users who come to swim, sail, camp, fish, relax and sun. Two methods of analysis and measurement were utilized: (1) a reservoir user survey, and (2) an input-output model or intersection transaction analysis. The user survey method gave an estimate of the gross expenditures by reservoir users. The input-output model showed the underlying structure and interdependencies of the microregional economy. One conclusion of the study is that the introduction of reservoir recreation at Whitney Point has not caused a spectacular economic growth in the microregion. (Grossman-Rutgers)
W70-07545

FLOOD PROOFING: AN ELEMENT IN A FLOOD DAMAGE REDUCTION PROGRAM,
Chicago Univ., Ill.
John R. Sheaffer.
Chicago, University of Chicago, 1960, 198p.

Descriptors: *Floodproofing, *Floods, *Flood damages, *Economic feasibility, Prices, Financing, Cost-benefit analysis, Flood plains, Flood protec-

tion, Salvage value, Economics, Insurance, Watersheds, Costs, Income, Value, Forecasting, Legal aspects, Regional flood.
Identifiers: *Bristol, *Flood adjustments, Flood risk, TVA.

This paper seeks to explore a possible method of mitigating flood damages as well as many of the techniques and economic advantages of private action to avoid flood damage where a flood hazard is already present. The concept of flood proofing is explained, included is an explanation of the elements of a program. A number of model programs are presented and their advantages and disadvantages discussed. The geographic area in study is described along with its flood history, future possible floods and the flood risks. Potential flood losses are estimated using various economic costing methods. Following this, there is a substantial discussion of the economic feasibility of flood proofing in the study area using the method of cost-benefit analysis. A selected sample of establishments in the hazard area was analyzed and the results extrapolated to arrive at an estimate of feasibility for the aggregate. The book concludes with some general observations on flood proofing. (Murphy-Rutgers)
W70-07561

POLLUTION: THE MESS AROUND US,
Wellesley Coll., Mass.
Marshall I. Goldman.
In: Controlling Pollution The Economics of A Cleaner America, Englewood Cliffs, Prentice-Hall, edited by M. I. Goldman, 1967, p 3-39. 40 p, 1 tab, 7 ref.

Descriptors: *Effluents, *Air pollution, *Water pollution, *Population, Pesticides, Fertilizers, Wastes, Sewage, Taxes, Economics, Irrigation, Input/output analysis, Investment, Regulation, Pricing, Rivers, Swimming, Boating, Reservoirs.
Identifiers: *Urban pollution, *Economic inducements, *External diseconomics, Subsidies.

This article discussed the recent surge of interest in pollution. It explains the complexity of the pollution problem and how this problem intensifies with expanding population. The biological view of the interrelation of population and pollution is given. The economic viewpoint is also presented and is at pointed contrast to the biological approach in its knowledge of historical and technological change. A historical development of pollution is given, along with its relation to industry. The problem of pollution control is explained in the economist's terms of external diseconomies. Air and water pollution are discussed, and several solutions are proposed including various forms of direct regulation and such items as subsidization and economic incentives. (Murphy-Rutgers)
W70-07565

THE INFLUENCE OF INFORMATION SIGNS ON VISITOR DISTRIBUTION AND USE,
Utah State Univ., Logan. Inst. for the Study of Outdoor Recreation Tourism.
Perry J. Brown, and John D. Hunt.
Journal of Leisure Research, Vol 1, No 1, p 79-83, Winter 1969. 2 fig, 6 ref.

Descriptors: Sampling.
Identifiers: *Information signs, *Visitor distribution, Advertising, Visitor use, Vehicle stoppage.

Lack of information is a primary factor accounting for visitor jamming recreation sites, overflowing onto highway rights-of-way and blocking facilities. In attempting to attain an even distribution of visitors, the importance of information signing as a management tool is often overlooked. Alfred Oxenfeldt has indicated that advertising (information) alters behavior most efficiently when it supplies information customers are seeking. R. Rocher and F. Kearns noted in visitor characteristic studies that travelers seek different experiences when touring than when at home. Information signs may lead the visitor to these different experiences. Hypothesizing that signs can influence facility use patterns, researchers at Utah State University in 1964 and 1965 conducted a visitor use and motivation study in the Logan Canyon Recreation Complex, Utah. This report focuses on two questions: (1) do information signs help distribute visitors more evenly. (2) Do information signs stimulate greater use of a previously unsigned roadside rest area. The authors conclude that information signs are instrumental in distributing use more evenly between roadside rest-stops and in estimating additional travelers to stop at facilities. They also prepare visitors to stop at facilities. This article may prove valuable to the recreation site manager attempting to increase the number of visits at water-oriented recreation facilities. (Loeb-Rutgers)
W70-07568

UNIFYING ELEMENTS IN THE THEORIES OF THE FIRM,
Patrick Yiung.
Quarterly Review of Economics and Business, Vol 9, No 4, p 21-28, Winter 1969. 8 p.

Descriptors: *Economic analysis, *Profits, *Management, Uncertainty, Linear programming, Model studies, Demand.
Identifiers: *Microeconomics, *Equilibrium, *Therory of firm, Nonmaximization, Joint maximization, Goals.

This article attempts to determine some of the unifying and catalytic elements in the different theories of the firm. The importance of microeconomic analysis in water industry planning makes knowledge of these elements important to the water resource planner. The unifying elements among the different approaches are discussed at different levels of considerations: (1) a general frame of reference, (2) a common drive toward equilibrium, (3) ties between maximizing and non-maximizing approaches, and (4) the coexistence of different goals. The major unifying elements are identified by citing examples from the literature and some suggestions are made with regard to potential development in the field. (Murphy-Rutgers)
W70-07578

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

A MODEL OF RATIONAL COMPETITIVE BIDDING,
Shell Development Co., Modesto, Calif.
For primary bibliographic entry see Field 06A.
W70-07235

A METHOD OF ALLOCATING FUNDS TO INVESTMENT PROJECTS WHEN RETURNS ARE SUBJECT TO UNCERTAINTY,
Smith (A. O.) Corp., Milwaukee, Wis.
For primary bibliographic entry see Field 06A.
W70-07238

THE DEMAND FOR WATER UNDER DYNAMIC CONDITIONS: A CASE STUDY OF BOULDER, COLORADO,
Colorado Univ., Boulder. Dept. of Economics.
For primary bibliographic entry see Field 06D.
W70-07329

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION - VIEWS FROM THE FEDERAL GOVERNMENT: A PANEL DISCUSSION,
Bureau of Reclamation, Denver, Colo. Div. of Project Development.
Jim T. Casey.
Conf. Proc., Comm. on the Econ. of Water Resources Develop., Denver, Colo., p 87-90, Dec 17-18, 1968. 4 p, 1 ref.

Descriptors: *Discount rate, *Evaluation, Economic efficiency, Federal government.

The Water Resources Council discount or interest rate based on a long-term cost of money will yield a higher rate. In the economic analysis process, the interest rate is one component. Present economic analysis needs reassessment in it is ultraconservative and it is directed only towards the goal of economic analysis and almost completely disregards the other objectives of resource development. Examples of these failings of economic analysis are presented. (Grossman-Rutgers)
W70-07546

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (BACKGROUND),
For primary bibliographic entry see Field 06E.
W70-07585

6D. Water Demand

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

THE DEMAND FOR WATER UNDER DYNAMIC CONDITIONS: A CASE STUDY OF BOULDER, COLORADO,
Colorado Univ., Boulder. Dept. of Economics.
Steve H. Hanke.
Available from the Clearinghouse as PB-192 119, $3.00 in paper copy, $0.65 in microfiche. Ph.D. Thesis 1969. 269 p, 22 tab, 26 fig, 5 append, 124 ref. OWRR Project A-005-COLO (11).

Descriptors: *Water demand, *Water rates, Data collections, Statistical methods, Colorado water utilization.
Identifiers: *Boulder (Colorado).

The effects of dynamic shift from a commodity charge of zero to a positive charge via metering of residential water are analyzed. Several models and techniques were utilized to analyze the time series data generated by the introduction of metered rates in Boulder Colorado; graphical analysis, qualitative analysis (interviews), and dynamic quantitative analysis. The conclusion states that the introduction of metered rates did have an effect on residential water consumption. (Grossman-Rutgers)
W70-07329

FORECASTING MUNICIPAL WATER REQUIREMENTS, SYSTEM TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 421, $55.00, Mag tape. Magnetic tape, computer program as documented in Hittman Associates report HIT-413, September 1969, Vol. III, 425 p.

Descriptors: *Water requirements, *Forecasting, *Municipal water, Computer programs, Water demand, Computer models, Statistical models, Regression analysis.

Methods for estimating municipal water requirements and for forecasting the values of municipal water use parameters have been combined to form a comprehensive forecasting method, called the MAIN II System. This tape contains the computer program developed to implement the MAIN II System. Complete documentation is contained in a User's Manual, PB-190 276, titled, 'Forecasting Municipal Water Requirements: Volume II, The MAIN II System User's Manual.' (See W70-04690 in Vol 3, No 12). The computer program is written in ASA Fortran IV language and the magnetic tape contains approximately 3700 records of up to 84 characters each. The tape is recorded in 7 chan-

nels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. The Library of Water Use Coefficients, required by this computer program, is recorded on a separate tape. (Boland-Hittman Assoc)
W70-07580

FORECASTING MUNICIPAL WATER REQUIREMENTS, LIBRARY TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 420, $55.00, Mag tape. Magnetic tape, library data as documented in Hittman Associates report HIT-413, September 1969, Vol II. 425 p.

Descriptors: *Water requirements, *Forecasting, *Municipal water, Computer programs, Water demand, Computer models, Statistical models, Regression analysis.

Methods for estimating municipal water requirements and for forecasting the values of municipal water use parameters have been combined to form a comprehensive forecasting method, called the MAIN II System. This tape contains the Library of Water Use Coefficients used in the implementation of the MAIN II System. The Library is required by the MAIN II System computer program, available on a separate tape. Complete documentation is contained in a User's Manual, PB-190 276, titled 'Forecasting Municipal Water Requirements: Volume II, The MAIN II System User's Manual.' (See W70-04690, Vol 3, No 12). The Library is written in source language format and the magnetic tape contains approximately 1300 records of up to 84 characters each. The tape is recorded in 7 channels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. (Boland-Hittman Assoc)
W70-07581

MAIN C: COMPUTERIZED METHODOLOGY FOR EVALUATION OF MUNICIPAL WATER CONSERVATION RESEARCH PROGRAMS, SYSTEM TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 422, $55.00, Mag tape. Magnetic tape, computer program as documented in Hittman Associates report HIT-409, August 1969, Vol II. 313 p.

Descriptors: *Water conservation, *Municipal water, Computer program, Computer models, Water requirements, Economic impact.

A computer model has been developed which estimates the influence of proposed water conservation devices, processes, or practices on the water requirements of an urban area, including the economic impact on the water supply utility. This tape contains the computer program developed to implement this model. Complete documentation is contained in a User's Manual, PB-190 278, titled 'MAIN C: Computerized Methodology for Evaluation of Municipal Water Conservation Research Programs, Volume II, User's Manual and System Documentation.' (See W70-04691, Vol 3, No 12). The computer program is written in ASA Fortran IV language and the magnetic tape contains approximately 3000 records of up to 84 characters each. The tape is recorded in 7 channels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. The Library of Detail Utilization Factors, required by this computer program, is recorded on a separate tape. (Boland-Hittman Assoc)
W70-07582

MAIN C: COMPUTERIZED METHODOLOGY FOR EVALUATION OF MUNICIPAL WATER CONSERVATION RESEARCH PROGRAMS, LIBRARY TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 423, $55.00, Mag tape. Magnetic tape, library data as documented in Hittman Associates report HIT-409, August 1969, Vol II. 313 p.

Descriptors: *Water conservation, *Municipal water, Computer program, Computer models, Water requirements, Economic impact.

A computer model has been developed which estimates the influence of proposed water conservation devices, processes, or practices on the water requirements of an urban area, including the economic impact on the water supply utility. This tape contains the Library of Detail Utilization Factors required in this analysis. The computer program which utilizes this Library is available on a separate tape. Complete documentation is contained in a User's Manual, PB-190 278, titled, 'MAIN C: Computerized Methodology for Evaluation of Municipal Water Conservation Research Programs, Volume II, User's Manual and System Documentation.' (See W70-04691, Vol 3, No 12). The Library is written in source language format and the magnetic tape contains approximately 1000 records of up to 84 characters each. The tape is recorded in 7 channels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. (Boland-Hittman Assoc)
W70-07583

6E. Water Law and Institutions

ANDERSON-TULLY CO V FRANKLIN (THALWEG OF MISSISSIPPI RIVER AS CONSTITUTING BOUNDARY BETWEEN MISSISSIPPI AND ARKANSAS; ACCRETION AND AVULSION CHANGES OF THALWEG).
307 F Supp 539-547 (ND Miss 1969).

Descriptors: *Mississippi, *Arkansas, *Accretion (Legal aspects), *Avulsion, Legal aspects, Judicial decisions, Erosion, Banks, Bank erosion, Boundaries (Property), Land, Land tenure, Rivers, Mississippi River, Navigable waters, Watercourses (Legal), Riparian waters, Riparian rights, Channels, Thalweg, Beds, Surveys, Maps, Meanders, Riparian land.

Plaintiffs Mississippi riparians instituted suit against defendants Arkansas riparians to quiet title in disputed land located along the Mississippi River, the thalweg of which constitutes the boundary between Mississippi and Arkansas. The dispute was generated by the shifting westward and southward of the thalweg along which the land was located. Ownership of the land depended on whether the land was located in Mississippi or Arkansas. Disposition of the case turned on whether the boundary line between the states ran along the thalweg or along a line of depression said to be the old river run. Plaintiffs alleged the land belonged to them as the result of gradual erosion on the Arkansas side and accretion on the Mississippi side, thus shifting the thalweg. Defendants contended the land was theirs because the shift in the thalweg was due to an avulsion and the boundary between the states remained the old thalweg. The federal district court ruled for plaintiffs on the basis of their clear preponderance of evidence. The boundary line between the states is the thalweg or main channel of the Mississippi River. Case law holds that if a shift in the thalweg is gradual, the boundary follows the shift. If it is sudden, due to an avulsion, the boundary remains the same. Here the shift was gradual and thus by accretion. The land was located in Mississippi and belonged to plaintiffs. (Duss-Florida)
W70-07256

THE RESPONSE OF THE NORTHEASTERN NEW JERSEY WATER TRANSFER NETWORK TO THE 1962-1966 DROUGHT,
Rutgers - The State Univ., New Brunswick, N. J. Dept. of Geography.
Robert M. Hordon.

In: Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), ed. Phillip Cohen, Martha N. Francisco, p 500-510, 7 fig, 13 ref.

Descriptors: *Water transfer, *Droughts, *Flexibility, *New Jersey.
Identifiers: *Graph theory, *Matrix applications, *Water supply agencies, Nodal degrees, Digraph, Linkages, Beta index, Gamma index, Theta index.

The response of a water transfer network to a severe drought is studied using graph theory and matrix applications to analyze nine northeastern counties in New Jersey from 1961 to 1967. During this period, there were 148 water supply agencies in the study area with consumption greater than 100,000 gpd. 91 of these engaged in varying amounts of inter-agency transfers. A network of these agencies called a digraph is presented. Each agency is represented by a node which is connected by directed lines, 'linkages', if there were any transfers during the period. The term 'nodal degree' expresses the number of links extending from a particular node to other nodes. Three indices are presented which express the topological characteristics of a network as it changes over time. The first index Beta denotes the relation between individual elements of a network, the second Gamma is a ratio between the nodes and the links of a network, the third, Theta is a measure of the average volume of water transferred to each node per time period. Expressions for each of these are presented, and suggestions are that the system responded in a relatively limited and rigid manner. Several questions are raised with regard to how other administrative structures might have responded. Matrix applications, their advantages and several applications, are outlined. Conclusions are that 'Balkanization' represents an inadequately connected system incapable of responding rapidly enough to stresses. (Preckwinkle-Chicago)
W70-07286

THE OPTIMAL ALLOCATION OF JURISDICTIONAL RESPONSIBILITY: THE PRINCIPLE OF FISCAL EQUIVALENCE,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Mancur Olson, Jr.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 321-331, 1969.

Descriptors: *Governments, *Administration, *Institutions, Water policy, Local governments, State governments, Economics.
Identifiers: *Public good, User charges, Incentives.

The establishment of institutional arrangements with appropriate functions, sizes and incentives is important to sound public policy implementation. Economic analysis should consider such institutional questions, otherwise built-in incentitives may handicap the intentions of the decision-maker. The disparate pattern of jurisdictions amony national, state, county and city governments, with their overlapping network of functions, raises questions as to optimum patterns of jurisdictional responsibility. The paper discusses the optimum match of functions and boundaries, including conditions which may lead to over- or under-production of governmental outputs. Patterns of beneficiary charges and cost sharing are relevant. Ethnic composition and other special non-economic conditions may justify additional governmental units. The author concludes that wide differences in the extent to which impacts of public goods are localized indicate that a broad array of governmental institutions is desirable, since a major discrepancy between the boundaries of a collective good and that of the jurisdiction which provides it is undesirable. The complex governmental network in the U.S. has many faults; but it is probably better than most of the arrangements which have been proposed to replace it. The considerations in the paper appear directly applica-

ble to the framework for administration of water resources. (See also W70-07288). (Whipple-Rutgers)
W70-07295

SWANGO V MCCOUN (INHERITANCE OF EASEMENT IN A SPRING).

301 Ky 219, 191 SW2d 388-390 (1945).

Descriptors: *Kentucky, *Easements, *Springs, *Access routes, Judicial decisions, Legal aspects, Bodies of water, Land tenure, Real property, Spring waters.

Plaintiffs brought suit seeking a judgment declaring them entitled to an easement in a spring. Plaintiffs' ancestor had conveyed to his son a life estate in an acre of land and in use of the spring. The property was to vest in fee simple in the son's heirs at his death. Plaintiffs' ancestor had also sold the land on which the spring was located to defendant's ancestor. Defendant had tried to prevent the son of plaintiffs' ancestor from using the stream but the courts had ruled the son had an easement in the spring and a right of access. After the son's death, defendants barred his heirs, the plaintiffs, from use of the spring. The trial court dismissed their petition, ruling that the right to use the spring was extinguished at the son's death. It based this on the deletion of the words 'and assigns' in the habendum clause of the original deed to the son. The Kentucky court of appeals reversed, ruling that the easement in the spring passed to the heirs regardless of the deletion. (Duss-Florida)
W70-07303

THE LAW OF THE SEA: NATIONAL POLICY RECOMMENDATIONS.
Rhode Island Univ., Kingston. Law of the Sea Inst.

Rhode Island University Technical Report, Proceedings 4th Law of the Sea Institute Conference, June 23-26, 1969, Kingston, Rhode Island; published April 1970. 533 p, 737 ref. Contract Nonr 396 (16), ONR Project No NR 388-083

Descriptors: *Conferences, *International law, *Continental shelf, *Marine fisheries, International waters, Deep-water habitats, Boundaries (Property), Boundary disputes, Offshore platforms, United States, United Nations.
Identifiers: *Sea law, Sea Institute Conference, National policy recommendations, Marine Science Commission.

This volume contains 19 professional papers, critiques of several of these, shorter articles by panel participants, and verbatim discussions covering the four-day conference. The program centered primarily about the international policy recommendations of the Marine Science Commission, and was broken down into the following major subheadings: the deep-seabed and continental shelf; fisheries arrangements; and freedom of scientific inquiry. There were also sessions on offshore boundaries and boundary determination, and on ocean strategy for the United States. Among the contributed papers in the volume are one on the Malta Plan and the United Nations, and another on Mathematical Economics and Marine Resources Research. (Lang-USGS)
W70-07359

THE LOUISIANA STREAM CONTROL COMMISSION'S WATER QUALITY STANDARDS AND PROGRAMS FOR THE LOWER MISSISSIPPI RIVER,
Louisiana Stream Control Commission, Baton Rouge.
For primary bibliographic entry see Field 05G.
W70-07385

INTERNATIONAL CONFERENCE ON OIL POLLUTION OF THE SEA.
For primary bibliographic entry see Field 05C.
W70-07411

UNION FALLS POWER CO V MARINETTE COUNTY (TAX ASSESSMENT OF FLOWAGE EASEMENTS).

238 Wis 134, 298 NW 598-601 (1941).

Descriptors: *Wisconsin, *Easements, *Taxes, *Assessments, Boundaries (Property), Industries, Legal aspects, Judicial decisions, Proprietary power, Relative rights, Riparian rights, Watercourses (Legal), Dams, Flooding, Overflow, Reservoirs, Local governments.

Plaintiff power company owned a dam across the Menominee River. It also owned a flowage easement over those lowlands upriver which were flooded by water impounded by the dam. Defendant county assessed the value of plaintiff's property to include the value of the flowage easement. Plaintiff contended that flowage easements are not real estate and are not assessable for tax purposes, but if they are, they must be assessed against the servient estate over which they flow. A Wisconsin statute defined real property to include rights and privilege appertaining to land. The court held that an appurtenant easement appertains to the dominant estate to which it belongs. As such, it comes within the definition of real property, and its value, for tax purposes, should be included in the assessment of the dominant estate. (Clarke-Florida)
W70-07435

HOLMES V HAINES (ACCRETION; BOUNDARY DISPUTES).
1 NW2d 746-751 (Iowa 1942).

Descriptors: *Iowa, *Boundary disputes, *Accretion (Legal aspects), *Boundaries (Property), Riparian land, Non-navigable waters, Legal aspects, Judicial decisions, Land, Land tenure, Streams, Banks, Beds, Erosion, Soil, Channels, Rivers, Low water mark, High water mark, Bank erosion, Watercourses (Legal).

Plaintiff and defendant were riparian owners along opposite sides of a non-navigable stream. Both had received title to their land through chains which contained no reservations regarding rights in the stream. The stream gradually eroded the defendant's bank and deposited accretions on plaintiff's bank. Defendant sought to establish a channel where the old stream ran. Plaintiff brought suit to quiet title in the accreted land and enjoin defendant from proceeding with the channel. The defendant claimed a fixed and permanent boundary which had never changed but had been destroyed, and that plaintiff had acquiesced in this. The trial court found for plaintiff and the Iowa supreme court affirmed. A conveyance along a stream carries title according to the intentions of the parties. In this case it was clear, as there was no contrary delineation in the titles given by the grantors, that the boundary line was the thread of the stream. The boundary line, being determined by the river, changed when the river changed. Moreover, the land accruing to plaintiff was due to accretion and therefore belonged to plaintiff regardless of whether the boundary line was the river bank or the water channel. (Duss-Florida)
W70-07436

HISTORIC ESTATES, INC V UNITED PAPERBOARD CO (EASEMENT TO SPRING-WATERS).
260 App Div 344, 21 NYS2d 819-823 (Sup Ct 1940).

Descriptors: *New York, *Easements, *Spring waters, *Water contracts, Overlying proprietor, Adjudication procedure, Judicial decisions, Land tenure, Legal aspects, Proprietary power, Relative rights, Water rights, Water transfer, Groundwater, Pumps, Water utilization, Springs, Remedies.

Defendant had a partially written, partially oral agreement with plaintiff's vendor that defendant would have the right to use water from a spring on vendor's land for 21 years. Defendant was to install and maintain a pump and pumphouse capable of supplying water to both plaintiff's and defendant's premises. Defendant fully complied with this agreement. Plaintiff, upon purchasing from vendor, sued to enjoin defendant from further use of the spring-water on the grounds that plaintiff had no actual or constructive notice of the alleged easement. There was no mention of it in any of the deeds applicable to plaintiff's property. The court found that a purchaser may assume that no easements which are not of record are attached to property. However, a purchaser is on notice of those easements that are open and visible and sufficient to indicate the existence of a servitude. In this case the pumphouse was locked, and defendant had the key. Also a power line ran directly from the pumphouse to defendant's premises. These facts were sufficient to put plaintiff on constructive notice that defendant was maintaining the pump to the spring, and the slightest inquiry would have revealed the easement agreement. (Clarke-Florida)
W70-07462

BIERY V CITY OF LIMA (USE OF EMINENT DOMAIN TO ACQUIRE EASEMENT).
255 NE2d 855-858 (Ohio Ct App 1969).

Descriptors: *Ohio, *Eminent domain, *Municipal water, *Cities, Local governments, Consumptive use, Water demand, Water supply, Water conservation, Water requirements, Condemnation, Utilities, Water works, Administration, Land tenure, Legal aspects, Easements, Right-of-way, Compensation, Judicial decisions, Public rights, Condemnation value, Pipelines.

Defendant city sought to establish an easement over plaintiff's property by exercising its power of eminent domain. The city intended to install a pipeline to increase the municipal water supply since local consumption of water was gradually increasing. The city alleged that the situation was an emergency, however, and sought to possess the property without first having compensation assessed by a jury. Plaintiff landowner sought an injunction to restrain the city from taking his property. The court held that the state constitution authorized appropriating property without first assessing compensation only where public exigency required it. The court found that the gradual increase in demand for water did not constitute an emergency or a sudden, pressing and critical need. Although wise policy would dictate a need for increasing the municipal water supply, no situation existed which could be termed a public exigency. The court issued an injunction restraining the city from entering into possession of the easement until a jury decided the amount of compensation due plaintiff. (Hubener-Florida)
W70-07466

ENERGETIC ENFORCEMENT OF INDUSTRIAL WASTE ORDINANCES,
Metropolitan Sanitary District of Greater Chicago, Ill.
Allen S. Lavin.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 550-553.

Descriptors: *Waste water (Pollution), *Legislation, *Water pollution control, *Industrial wastes, Pollution abatement, Taxes.
Identifiers: Industrial waste ordinances, Anti-pollution laws, Law Enforcement, Tax incentive laws.

The laws and ordinances of agencies charged with the responsibility of protecting our waters against pollution have not been and are not being enforced. There are two controlling factors causing a lack of enforcement. First, it is in the very nature of our economic system that industry will not expend funds that add to the cost of their product until the law demands it. Second, it is the nature of

democratic forms of government that legislatures will not enact new laws, nor will executives enforce them unless the people demand it. Due to public sentiment, government is now being forced into a more active anti-pollution program. The presence of laws, funds, public support, and technology have, however, yet to be coordinated into an effective enforcement program. Most industries, when/and with a summons to show cause why they should not be fined and enjoined for pollution activities, will voluntarily adopt anti-pollution facilities rather than face being the defendant at hearings or in lawsuits and having their public image tarnished. Tax incentive laws will help encourage industry to comply with anti-pollution laws and to provide waste treatment facilities. (Makela-Texas)
W70-07490

SOME LEGAL AND ECONOMIC IMPLICATIONS OF SEA-WATER INTRUSION - A CASE STUDY OF GROUNDWATER MANAGEMENT,
Economic Research Service, Washington, D.C. Farm Production Economics Div.
For primary bibliographic entry see Field 04B.
W70-07524

DANA S COURTNEY CO V QUINNEHTUK CO (EFFECT OF CONTRACTING AWAY WATER RIGHTS).

20 NE2d 399-401 (Mass 1939).

Descriptors: *Massachusetts, *Dams, *Alteration of flow, *Contracts, Judicial decisions, Damages, Damsites, Diversion dams, Diversion structures, Flow control, Water control, Water supply, Powerplants, Flow, Low flow, River flow, Diversion, Duty of water, Obstruction to flow, Relative rights, Diversion losses, Prescriptive rights, Water rights, Legal aspects, Land tenure.

Defendant owned a dam and powerplant on a river above plaintiff's dam and powerplant. Changes in defendant's operation substantially reduced the amounts of water reaching plaintiff's dam, and plaintiff sued for damages and injunctive relief. The court denied relief upon a finding that plaintiff had contracted away his rights to an undiminished flow of water. In earlier deeds executed by the respective predecessors in title defendant was given unlimited rights to the water in the stream, and the court found that plaintiff's water rights were subordinate to the rights of defendant to divert as much water as he saw fit for any purpose. The deeds clearly negatived any implied easement of a sufficiency of water in plaintiff's favor. The court further found that plaintiff had not acquired water rights by precription because no water had been taken adversely to defendant. The water received by plaintiff was under his right as a lower proprietor to receive such water as defendant did not choose to divert. (Douberley-Florida)
W70-07525

R DUNKEL, INC V BARLETTA CO (LIABILITY FOR DAMAGE CAUSED WHILE CONSTRUCTING CULVERTS).
18 NE2d 377-379 (Mass 1938).

Descriptors: *Massachusetts, *Conduits, *Overflow, *Construction, Judicial decisions, Damages, Flood damage, Culverts, Conveyance structures, Rain, Rain water, Runoff, Obstruction to flow, Barriers, Streamflow, Concrete placing, Casings, Excessive precipitation, Streams, Floods, Legal aspects.
Identifiers: *Freshets, Negligence.

A small brook flowed through a culvert under the floor of the basement of a building occupied by plaintiffs. During a rainstorm the culvert overflowed and plaintiffs' property was damaged. Defendant was sued for damages on grounds that the overflow was caused by obstructions placed in the culvert below the premises by defendant. Defendant had placed concrete forms in the culvert pursuant to a contract with the city to construct a conduit for the brook. The court found that the obstruction caused by the forms themselves was not negligence because it was a necessary incident to the proper performance of the contract. There was no negligence unless the erection of the obstruction was performed in a careless and negligent manner, and the jury did not so find. The court also found no evidence upon which the jury could have found the increased flow sufficient to constitute such a freshet as to make the narrowing of the passage actionable. (Douberley-Florida)
W70-07526

MILLSPAUGH V NORTHERN INDIANA PUBLIC SERVICE CO (TORT LIABILITY FOR DEATH OF FISHERMAN IN NON-NAVIGABLE, PRIVATE STREAM).

12 NE2d 396-402 (Ind Ct App 1938).

Descriptors: *Indiana, *Drowning, *Permits, *Fishing, Judicial decisions, Public rights, Underwater, Hazards, Safety, Damages, Dams, Dam construction, Damsites, Overflow, Sport fishing, Non-navigable waters, Ownership of beds, Streambeds, Precriptive rights, Powerplants, Easements, Relative rights, Legal aspects.
Identifiers: Fishing rights.

Plaintiff sued defendant power company for the wrongful death of plaintiff's husband, who drowned while fishing in a stream, the level of which was raised by defendant's dam. When the dam was constructed defendant had failed to completely destroy a submerged older dam, and the boat of the deceased capsized because of currents created around the remaining portions of the dam. The court found that the decedent did not have a right to use the waters for fishing. At the point where the boat capsized the stream was non-navigable and therefore subject to private ownership. Since defendant owned the banks of the stream, and therefore the stream bed, the court held that it also held exclusive rights for fishing. No public easement existed for fishing on private waters, and the decedent had not acquired fishing rights by prescription. Even if the decedent had been viewed as a licensee, the court found that he would have been a licensee by permission and not by invitation. As such, he took the premises as he found them, and defendant was not held to be liable to the licensee for any injuries owing to defects in the condition of the premises. (Douberley-Florida)
W70-07532

MIDDLE ISLAND LAND AND WATER CO V HUTNER (EFFECT OF IMPROPER TAX DEED ON OWNERSHIP OF BEDS).

259 App Div 294, 19 NYS2d 176-181 (Sup Ct 1960).

Descriptors: *New York, *Boundary disputes, *Ownership of beds, *Taxes, Adjudication procedure, Boundaries (Property), Judicial decisions, Land tenure, Legal aspects, Local government, Proprietary power, Riparian land, Riparian rights, Non-navigable waters, Lakes, Lake beds, Assessments, Relative rights.
Identifiers: *Liens.

Plaintiff owned a large tract of land on which was located a non-navigable lake. Plaintiff conveyed a 2 1/2 acre plot under the lake by purchase money mortgage. Two years later the county foreclosed against the mortgagor for failure to pay the property taxes, and issued to defendant a tax deed which described the property to include the 2 1/2 acre underwater plot. Plaintiff contended that his mortgage lien was superior to the tax lien upon which the tax deed rested. The court found that the county had assessed the entire bed of the lake against the plaintiff during the delinquent years, and that the plaintiff had paid the taxes so assessed, including those on the 2 1/2 acre plot. Thus, the tax lien was based in part upon a plot of land on which there were no unpaid taxes. A tax lien is either valid or invalid in its entirety; therefore the tax deed to defendant was void. Plaintiff retained his mortgage and defendant received a judgment against the county for amounts paid thereto. (Clarke-Florida)
W70-07540

ADMINISTRATION OF WATER RESOURCES IN NEW MEXICO,
New Mexico State Univ., University Park. Water Resources Research Inst.
Ira G. Clark.
Available from the Clearinghouse as PB-192 311, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute, WRRI Research Report No. 3, June 1968. 30 p, 2 charts. OWRR Project A-012-NMEX (2).

Descriptors: *Administrative agencies, Domestic water, Public acequias, Drainage districts, Interagency cooperation, *Local governments, Public health, Reclamation, Recreation, Small watersheds, Soil conservation, *State jurisdiction, Water districts, Water permits, Well regulation, *New Mexico, Interstate commissions, Irrigation districts, Water law.
Identifiers: Conservancy districts.

This manual contains a brief summary of New Mexico water law, following by a concise description of every agency -- state, local, or federal -- which has any substantial connection with the administration of the water resources of the state. The basic information relating to the state and local agencies is reduced to two charts. The result is a compact, ready-reference handbook which, for the first time, supplies a comprehensive overview of all such agencies operating in the state, and basic information on each; organization and administration; activities (supervisory, planning and design, construction, operation and maintenance); economic and conservation functions; special powers (fiscal, regulatory, eminent domain, etc.). Sources for the handbook were the New Mexico Revised Statutes, Code of Laws of the United States, United States Government Organization Manual for 1967-68, and reports and releases of the agencies themselves.
W70-07543

RILEY V JONES (PRESCRIPTIVE RIGHT TO USE SPRING WATERS).

295 Ky 389, 174 SW2d 530-532 (Ct App 1943).

Descriptors: *Kentucky, *Prescriptive rights, *Easements, *Spring waters, Water rights, Legal aspects, Judicial decisions, Springs, Land, Land tenure, Wells, Pipes, Water utilization, Pipelines, Right-of-way, Relative rights, Real property.
Identifiers: *Adverse possession.

Plaintiff brought suit to enjoin defendant from interfering with plaintiff's right to receive water on his land from a spring located on defendant's land. Originally, the lands of plaintiff and defendant had been under common ownership. The original owner had created a dominant-servient estate relationship by selling the land containing the spring but reserving the right to use the water by way of a pipe to his remaining land. Later, both tracts of land eventually came under common ownership again, without any reservation for use of the spring water. Plaintiff and defendant then come to own the respective tracts and in defendant's deed to the land containing the spring there was recital of the original reservation concerning use of the water. Plaintiff contended that the right of the dominant estate was revived even though the two estates had been reunited without any reservation, and that the plaintiff had acquired the right by adverse possession. The Kentucky court of appeals affirmed the trial court's granting of an injunction on the basis of adverse possession. It found that the merger of the original estates had extinguished the pre-existing easement. Such easements are revived in case of

severance only if they are 'ways of necessity.' However, the recitals of the reservation in defendant's deed put defendant on notice of the water pipe and plaintiff's actual use ripened into a prescriptive right after fifteen years. (Duss-Florida)
W70-07558

PUBLIC OWNERSHIP CONSTRAINTS ON UTILITY MANAGEMENT,
Oregon Univ., Eugene.
Roy J. Sampson.
Journal of the American Water Works Association, Vol 61, No 10, p 495-499, October 1969, 5 p.

Descriptors: *Management, *Public utilities, *Planning, *Pricing, Economic evaluation, Profits, Regulation, Competition, Forecasting, Economic efficiency, Prices, Taxes, Costs, Financing, Water rates.
Identifiers: *Social values, *Private utilities, Rate of growth.

The article discusses a number of management issues arising out of the existence of publicly regulated or publicly owned water utilities. The author feels that the overriding problem for these utilities is to achieve a balance between public and private ownership, regulation and nonregulation, and managerial flexibility and managerial constraints that will allow them to regain and retain as much of the innovative spirit of management as possible. This should be in conjunction with giving the public the most economically efficient service and protecting it against the possible abuses. This would require that publicly-owned businesses be operated as nearly as possible like privately-owned businesses and that regulated businesses be subjected only to the minimum socially necessary regulation. The author gives attention to the management functions and explains the pricing concepts that should be followed. (Murphy-Rutgers)
W70-07560

SCOTTISH RIVER PURIFICATION BOARDS,
Organization for Economic Co-Operation and Development, Paris (France).
Fred H. Hubbard.
Natural Resources Journal, Vol 9, No 4, p 489-517, October 1969. 1 fig, 4 tab.

Descriptors: *Water pollution, *Water pollution control, Water management, Wastes, Construction, Waste treatment.
Identifiers: *River purification boards, Scotland, Arrangements, Discharge license, Consent condition, Enforcement, Fish life, Regionalization.

Arrangements for administering programs are fundamental to success in solving the problem of water pollution. Arrangements are, however, difficult to develop, particularly in modern urban settings involving large geographical spaces, complex hydrologic conditions, large populations with different social and economic interests, and varied legal and political responsibilities. A large body of literature has been published in recent years calling attention to the significant role arrangements play in water management. When an arrangement is developed that appears to achieve this difficult task, it is a matter of interest for possible application elsewhere such as in pollution control in outdoor recreation water facilities. This article is based on information obtained from Scottish pollution control officials and other informative sources during September 1967 to May 1968. This article focuses attention on the river purification program. It discusses organization and operation of river purification boards and the results achieved. It also assesses the boards' contribution to controlling pollution. (Loeb-Rutgers)
W70-07566

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (BACKGROUND),
Jeffery O'Connell.
Iowa Law Review, Vol 47, No 3, p 549-557, Spring 1962. 8 p, 58 ref.

Descriptors: *Iowa, *Water permits, *Water shortage, *Water rights, Legislation, Humid areas, Permits, Administrative agencies, Regulation, Surface waters, Groundwater, Water resources development, Flood control, Planning, Census, Surveys, Consumptive use, Irrigation, Domestic water, Industrial use (Water), Droughts, Water users, Riparian rights, Water utilization, Optimization, Legal aspects.

With strains on the availability of water, the humid Eastern states, including Iowa, are turning to the Western approach of regulating water by the issuance of permits from the government. In 1957, Iowa established a permit system administered by a Water Commissioner and regulating both surface and groundwater. An earlier statute had set up a Natural Resources Council to institute a state-wide program for flood control and water resources conservation and development. It was also to establish and enforce a comprehensive plan for water control. The Council's inventory of available water indicated a possible water crisis. Irrigation was found to be the most consumptive use because vast quantities are required and it is not returned to the source. Per capita consumption also has increased dramatically because of more uses in the home and greater consumption by industry. Severe draughts in the mid-1950's caused concern among water users of all types, and it became obvious that the wasteful riparian rights system was inadequate to cope with the crisis. The Council recommended changes in the Iowa water law, and the 1957 Water Rights Law resulted. (See also W69-00338) (Douberley-Florida)
W70-07585

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (TERMS OF THE STATUTE AND THE HYDROLOGIC CYCLE),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 557-565, Spring 1962. 8 p, 48 ref.

Descriptors: *Iowa, *Water rights, *Legislation, *Hydrologic cycle, Beneficial use, Domestic water, Industrial water, Municipal water, Water permits, Permits, Administrative agencies, Administration, Regulation, Natural streams, Diversion, Withdrawal, Storage, Groundwater, Drainage water, Settling basins, Surface runoff, Impoundments, Impounded waters, Hydrologic aspects, Water sources.

Iowa's new water statute requires that the state's water resources be put to beneficial use to the fullest extent. Waters in any natural waterbody are public waters and subject to state control and development. The act establishes a permit system administered by a Water Commissioner. It requires permits for the diversion, storage or withdrawal of water from any watercourse, underground source, drainage ditch or settling basin. Exempt or non-regulated uses include domestic uses and existing beneficial uses within municipal corporations. Persons also retain the right to use and drain diffused surface waters and to impound water on their own property. Most water users in municipalities are not required to procure permits. The procedure for obtaining a permit requires notice and a hearing, with provisions for appeal. The Commissioner determines whether the use will be in the public interest and whether the average minimum flow is preserved. Permits are granted for a maximum of ten years. The permit does not constitute an absolute right to use, for the waters are subject to the principle of beneficial use. Provisions are made for extending, cancelling, modifying or suspending permits. The hydrologic cycle is outlined in brief. (See also W69-00338) (Douberley-Florida)
W70-07586

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (PRE STATUTORY SURFACE WATER RIGHTS),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 565-568, Spring 1962. 4 p, 18 ref.

Descriptors: *Riparian rights, *Natural flow doctrine, *Reasonable use, *Iowa, Water rights, Surface waters, Riparian land, Artificial use, Alteration of flow, Domestic water, Irrigation water, Industrial water, Natural use, Prior appropriation, Relative rights, Usufructuary right, Riparian water loss, Riparian waters, Beneficial use, Preferences (Water rights), Administration, Humid areas, Legal aspects, Water utilization.

Prior to the enactment of Iowa's new water rights law, Iowa, like most humid Eastern states, followed the doctrine of riparian rights in governing the use of surface water in watercourses. The doctrine is one of two general systems used in the United States and is itself comprised of two different theories. Under the natural flow theory, each riparian owner is entitled to have the watercourse maintained in its natural state, although each has the right to use water for his natural and artificial uses on riparian land. Under the reasonable use theory, each riparian owner can make a beneficial use of water so long as he does not unreasonably interfere with the same right of any other riparian. Under the natural flow theory, a cause of action accrues even if there is no harm to anyone, and water use is restricted to riparian land. Under the reasonable use theory, there must be an unreasonable interference with another's rights, and water may be used on non-riparian land. Most courts combine the two theories when dealing with riparian rights. Domestic uses are usually considered to be reasonable, and any non-riparian use is unreasonable per se. (See also W69-00338) (Douberley-Florida)
W70-07587

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (ADVANTAGES OF THE STATUTE OVER COURT ADMINISTERED RIPARIAN RIGHTS LAW),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 568-577, Spring 1962. 9 p, 46 ref.

Descriptors: *Groundwater, *Surface-groundwater relationships, *Administrative agencies, *Iowa, Riparian rights, Hydrogeology, Subsurface waters, Percolating water, Underflow, Bodies of water, Groundwater basins, Groundwater movement, Hydrologic cycle, Overlying proprietor, Underground streams, Beneficial use, Judicial decisions, Administration, Surface waters, Planning, Legal aspects, Permits, Appropriation, Legislation.

Owners above underground streams have riparian rights similar to surface rights. It is presumed that underground water is percolating water, however, and it is often treated as a paat of the real estate. Before the statute, Iowa held that the owner of the land could, without wasting it, use the groundwater for any beneficial purpose. To allow unrestricted use of groundwater but only reasonable use of surface water ignores the hydrologic cycle. Legal doctrine often ignores geologic fact because the artificial classifications of the phases are literally observed. There is no real distinction between percolating waters and underground streams. The courts lack expertise and have not been able to implement comprehensive plans. Courts cannot take preventive action and cannot reach those not party to suits. Court procedures are also very costly. Administrative agencies on the other hand have the needed expertise. They are not limited to considering the instant dispute, but must consider the public's interests. The individual decisions arising out of permit application fit into a comprehensive plan. The Iowa agency administers a combination of riparian-appropriation system, although the con-

cept of riparian rights is changed very little by the new Iowa statute. (See also W69-00338). (Douberley-Florida)
W70-07588

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (WASTE UNDER THE RIPARIAN DOCTRINE AND THE NEW STATUTE),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 577-581, Spring 1962. 4 p, 18 ref.

Descriptors: *Iowa, *Optimum development plans, *Water utilization, *Permits, Legislation, Water resources development, Planning, Water conservation, Riparian rights, Riparian owners, Riparian land, Riparian waters, Water rights, Reasonable use, Preferences (Water rights), Competing uses, Water allocation (Policy), Legal aspects.

Waste of water resources is inherent in the riparian rights system. Only small riparian tracts abutting the watercourse may benefit from the water, and rights are so vague that users are often afraid to make full use of the water. The Iowa act does not limit water to riparian uses. The permit gives the permittee some assurance of water, at least for the term of the permit. The cost of granting certain, perpetual rights would be an inflexible system and continued waste of water resources. The maximum permit is therefore ten years, although they are usually limited to seven years. The short term poses some problems for capital investments, but the Water Commissioner has seen no adverse effects. Water rights are still uncertain over a long period of time, and this results in some waste, but it is an improvement over the uncertainty of the reasonable use theory. Some certainty is sacrificed for flexibility. (See also W69-00338) (Douberley-Florida)
W70-07589

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (RIPARIAN RIGHTS AS VESTED RIGHTS),
Jeffery O'Connell.
Iowa Law Review, Vol 47, No 3, p 581-594, Spring 1962. 13 p, 90 ref.

Descriptors: *Water rights, *Compensation, *Riparian rights, *Iowa, Water allocation (Policy), Legislation, Preferences (Water rights), Water contracts, Water permits, Navigable waters, Ownership of beds, Streambeds, Judicial decisions, Iced lakes, Natural use, Domestic water, Regulation, Regulated flow, Artificial uses, Water utilization, Stock water, Reasonable use, Municipal water, Groundwater, Legal aspects.

In determining whether due process requires that compensation be paid for taking vested water rights, the essential question is whether the statute unreasonably alters expectations normally flowing from the property interest. The general view is that there are no private property rights in navigable streams, and it has been argued that Iowa's water rights statute does not affect riparian rights in streams with privately owned beds. Because natural or domestic uses are the equivalent of nonregulated uses, the right to water for domestic uses is preserved by the established average-minimum-flow concept. Also, rights to water for artificial uses are vested and preferred to any nonriparian's rights. However, it is not clear from the statute that riparian rights are preserved. The statute abolishes unused existing rights, and existing uses may have been changed by allowing unlimited use for livestock as a domestic use. The statute also treats municipal uses as equivalent to domestic uses, which may affect uses by riparians. The statute substantially changes rights to groundwater, which indicates that riparian rights were not preserved intact. (See also W69-00338) (Douberley-Florida)
W70-07590

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (THE COURTS' VIEWS OF WATER LEGISLATION),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 594-606, Spring 1962. 12 p, 75 ref.

Descriptors: *Riparian rights, *Water allocation (Policy), *Relative rights, *Public rights, Oregon, Judicial decisions, Legislation, Compensation, Regulation, State governments, Beneficial use, Water conservation, Administration, Water rights, Competing uses, Remedies, Administrative decisions, Water policy, Iowa, Legal aspects.
Identifiers: Vested rights.

To say that riparian rights are vested rights is not to say that they cannot be subject to state regulation without compensation. State ownership of water is not ownership in a proprietary sense. Because of the nature of water, riparian rights are susceptible to change by regulation, and a change in water rights by reasonable regulation does not deprive a riparian of property without due process of law. The Supreme Court favors state legislation regulating economic interests, and because of its importance the Court has been particularly deferential toward state action concerning water. Recognizing the states' interest in water, the Court would be expected to readily defer to a state's decision to change its system of water law to insure the beneficial use and conservation of water. The Oregon courts have upheld statutes that subjected water rights to reasonable regulation in the public welfare, even where vested riparian rights were substantially modified. (See also W69-00338) (Douberley-Florida)
W70-07591

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (DISTINCTION BETWEEN EXISTING AND UNUSED RIGHTS TO WATER),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 606-615, Spring 1962. 9 p, 63 ref.

Descriptors: *Riparian rights, *Equitable apportionment, *Iowa, *Usufructuary right, Water distribution (Applied), Legislation, Water rights, Preferences (Water rights), Regulation, Relative rights, Water allocation (Policy), Water contracts, Water utilization, Water users, Optimization, Public rights, Navigable waters, Governments, Legal aspects.

The Iowa water statute would probably be held constitutional if construed as regulating only unused rights while preserving existing uses, but it is questionable whether the distinction is so basic as to justify a constitutional differentiation. The property interest in a riparian right is only usufructuary; it is a right to have the water flow to the owner for capture. The only distinction between existing and unused rights is how soon the right will be exercised. Even the bare right to use water is limited by the supply, governmental controls, and the reciprocal rights of others, which are preserved by rules of equitable distribution. The more the right is made uncertain by these factors, the less likely a change by legislation will be unconstitutional. The right to gain available water is in the nature of a property interest, but there is no property interest in the rules for equitable distribution prevailing at any time. A change in the rules that destroys equitable distribution will be unconstitutional, but a change that reflects changing needs will be more likely to be upheld. The system may constitutionally change if it is in the public interest and does not disturb the reasonable expectations of those with a right to use the water. (See also W69-00338) (Douberley-Florida)
W70-07592

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING USES OF WATER (CHANGES MADE BY THE STATUTE).
Jeffrey O'Connell.
Iowa Law Reviews, Vol 47, No 3, p 615-626, Spring 1962. 19 p, 104 ref.

Descriptors: *Iowa, *Riparian rights, *Water rights, *Legislation, Relative rights, Administrative agencies, Adjudication procedure, Water permits, Domestic water, Stock water, Municipal water, Industrial water, Industrial water, Artificial use, Regulation, Reasonable use, Competing uses, Equitable apportionment, Prescriptive rights, Water distribution (Applied), Water allocation (Policy), Legal aspects, State governments.

The Iowa water statute provides for the determination of proper use by a Water Commissioner, not after a dispute arises, but before the issuance of a permit. Except for the rights of nonriparians, the statute makes few changes because of the similarity between statutory nonregulated uses and common law domestic uses. The statute exempts uses for livestock, but this does not work a material change in existing law. Certain municipalities and industrial users are changed from the artificial uses classification to a domestic uses classification, but there is existing authority that municipal uses take precedence over other riparian rights as being in the public interest and as domestic uses. The statute applies the reasonable use standard to artificial uses, changes the rule by emphasizing priority of use when the permit is issued, allows a permit even where another is issued, and allows apportionment among competing users. The provision for loss of water rights for nonuse is only a shortening of the time for loss by prescription under the common law, and in practice this change will not be a drastic one. (See also W70-07584) (Douberley-Florida)
W70-07593

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (CONCLUSION).
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 634-636, Spring 1962, 3 p, 7 ref.

Descriptors: *Iowa, *Compensation, *Equitable distribution, *Adjudication procedure, Legislation, Water rights, Hydrologic aspects, Hydrology, Reasonable use, Administration, Administrative agencies, Water permits, Regulation, Federal government, State governments, Riparian rights, Relative rights, Legal aspects.

The Iowa water statute makes changes in common law rights to water, but it is not thereby unconstitutional. The test of constitutionality should be whether the legislation is rationally designed to solve the problems it purports to solve and whether the change in property rights is so drastic and unexpected that fairness calls for compensation. The common law doctrines are hydrologically unsound and common law rights are so uncertain that they may be subjected to substantial change without being unconstitutionally impaired. The Iowa statute preserves an equitable system of distribution similar to the doctrine of reasonable use. The determination of reasonable use is constitutional under both the federal and Iowa constitutions. The statute may not be the best possible approach, but it is within the zone of reasonableness and therefore is constitutional. (See also W70-07584) (Douberley-Florida)
W70-07594

FLUCTUATING SHORELINES AND TIDAL BOUNDARIES: AN UNRESOLVED PROBLEM.
Peter K. Nunez.
San Diego Law Review, Vol 6, No 3, p 447-469, July 1969. 23 p, 94 ref.

Descriptors: *California, *Shores, *High water mark, *Boundary disputes, Tides, Boundaries (Property), Judicial decisions, Legal aspects, Accretion

(Legal aspects), Avulsion, Bank erosion, Water law, Water rights, Littoral, Oceans, Ocean waves, Sea level, Tidal effects, Water levels, Beaches, Littoral drift, Intertidal areas, Beach erosion, Riparian rights, Reservation doctrine, Submerged Lands Act, Relative rights, Ownership of beds.

The California case of People v William Kent Estate Co is analyzed in view of various principles and laws affecting tideland ownership. The issues of the case involve beach front property and a fluctuating shoreline. The determination of tidal boundaries and the types, uses and computation of tidal datum are discussed. As a general American rule, the common law principles of tidal ownership are accepted-- title to all lands below the ordinary high water mark belongs to the sovereign. However, a significant number of coastal states have adopted the use of other tidal datum to determine tideland ownership. An examination of the various attempts to define ordinary tides is presented. The English, federal, and California definitions of ordinary tides are examined. The boundary problem in this case involved more than a misapplication of the California rule concerning the computation of ordinary or mean high tides. The fluctuating shoreline created the issue as to the characterization of the fluctuations as natural erosion and accretion or alluvion and avulsion. Another issue involved how long a period of time must pass for a change to be gradual and imperceptible in order to be classed as an accretion rather than an avulsion. The court's determination of these issues is reviewed. The court's novel proposal for determining the location of the tidal boundary is discussed. Two alternative methods of determining such boundaries are also presented. (See also W70-07596 thru W70-07597) (Powell-Florida)
W70-07595

FLUCTUATING SHORELINES AND TIDAL BOUNDARIES: AN UNRESOLVED PROBLEM (LOCATION OF TIDAL BOUNDARIES).
Peter K. Nunez.
San Diego Law Review, Vol 6, No 3, p 447-461, July 1969. 15 p, 73 ref.

Descriptors: *California, *Shores, *Boundary disputes, *High water mark, Tides, Boundaries (Property), Judicial decisions, Legal aspects, Accretion (Legal aspects), Avulsion, Bank erosion, Littoral, Oceans, Ocean waves, Sea level, Tidal effects, Water levels, Beaches, Littoral drift, Intertidal areas, Beach erosion, Riparian rights, Relative rights, Low water mark, Surveys, Measurement.

The location of a tidal boundary is dependent upon the fluctuations of the tides. From observations of the tides, tidal datum planes are computed. Tidal boundaries involve two engineering aspects: a vertical one, predicated on the height reached by the tide during its vertical rise and fall, and constituting a tidal plane or datum; and a horizontal one, related to the line where the tidal plane intersects the shore to form the tidal boundary desired. Characteristics of tides are influenced by four factors: (1) tide-producing forces of the sun and moon; (2) bottom topography and configuration of the major ocean basins; (3) bottom topography and configuration of bays and estuaries; and (4) meteorological phenoma. To obtain a reliable mean value for tidal datums, because of astronomic factors which have a 18.6 year cycle, tides are observed for almost 19 years. Daily, semidaily and mixed are the three types of tides. Of the four tidal datums, mean low water, mean high water, mean lower low water and mean higher high water, the former two have received almost universal acceptance because they are incidental of all three types of tides. The United States Coast and Geodetic Survey determines these values. *See also W70-07595) (Powell-Florida)
W70-07596

FLUCTUATING SHORELINES AND TIDAL BOUNDARIES: AN UNRESOLVED PROBLEM (ACCRETION AND AVULSION).
Peter K. Nunez.
San Diego Law Review, Vol 6, No 3, p 462-469, July 1969. 8 p, 19 ref.

Descriptors: *California, *Shores, *Accretion (Legal aspects), *Avulsion, Boundary disputes, High water mark, Tides, Boundaries (Property), Judicial decisions, Legal aspects, Bank erosion, Littoral, Ocean waves, Sea level, Tidal effects, Water levels, Beaches, Littoral drift, Intertidal areas, Beach erosion, Riparian rights, Relative rights, Surveys, Measurement, Low water mark.

Accretion is the gradual and imperceptible accumulation of land by natural causes. Avulsion is the loss of lands bordering on the seashore by sudden or violent action of the elements, perceptible while in progress. The distinction between the two involves an issue of time--how long a period of time must pass for a change to be gradual and imperceptible. The common-law test is that though the witnesses may see from time to time that progress has been made, they cannot perceive it while the process was going on. The court in People v William Kent Estate Co, 242 Cal App 2d 156, 51 Cal Rptr 215 (1966), in determining the location of the boundary, directed the parties to attempt to determine the average line of the shore against which the ordinary high-water datum could be applied. This would create a fictional but stable shoreline. There are two other proposals for determining tidal boundaries. The first possibility is to adopt as the boundary the ordinary high-water mark as it exists when erosion has had its maximum effect, when that mark is at its extreme landward migration. The other solution is the opposite extreme: adopt as the boundary the ordinary high-water mark as it exists when accretion is at its maximum. (See also W70-07595) (Powell-Florida)
W70-07597

SCHMIDT V MARSCHEL (TITLE TO ACCRETED LANDS; ADVERSE POSSESSION).
2 NW2d 121-124 (Minn 1942).

Descriptors: *Minnesota, *Accretion (Legal aspects), *Riparian rights, *Boundary disputes, Land tenure, Legal aspects, Judicial decisions, Navigable water, Land, Non-navigable waters, Lakes, Riparian land, Shores, High water mark, Meanders, Bodies of water, Watercourses (Legal), Relative rights, Boundaries (Property).
Identifiers: *Adverse possession.

Plaintiffs brought suit to partition a tract of relicted land situated between a lake shore and plaintiffs' property. Defendant, property owner adjacent to plaintiffs, had occupied the land and treated it as his own for a 44 year period before the suit. The trial court concluded that the defendant was owner in fee simple, having acquired title by adverse possession, and the Minnesota supreme court affirmed. Riparian owners take title to land on navigable lakes to the high water mark and have rights to accretions and relictions. However, a riparian owner of such land may be divested thereof by adverse possession. The evidence clearly established that defendant acquired title by adverse possession, having used the property in various agricultural pursuits including renting the disputed land to plaintiffs for pasture. The fact that defendant did not intend to take land not belonging to him does not remove the element of hostility required in adverse possession. His possession was actual, open, notorious, and hostile, and title ripened despite his state of mind as to the actual ownership. (Duss-Florida)
W70-07598

MCCOY V RANKIN (NATURAL FLOW EASEMENT ACROSS LOWER ESTATE)

42 NE2d 234-240 (Ohio Ct App 1941)

Descriptors: *Ohio, *Natural flow, *Repulsion (Legal aspects), *Riddance (Legal aspects), Surface drainage, Surface runoff, Obstruction to flow, Legal aspects, Judicial decisions, Land, Land use, Land tenure, Easements, Embankments, Overflow, Dams, Ditches, Drains, Tile drains, Damages, Channels, Watercourses (Legal), Discharge (Water), Civil law.
Identifiers: *Servitudes.

Plaintiff upper landowner brought suit to enjoin defendant lower landowner from maintaining a dam across a drainage ditch. It was contended that the dam obstructed the natural flow of surface water and backed it up onto plaintiff's land. Prior to the construction of defendant's dam, the plaintiff had constructed on his premises a tile drain which discharged into the ditch. At the trial defendant alleged plaintiff's actions had increased the flow of the ditch beyond capacity, thus damaging defendant's land and justifying the dam. The trial court found for the plaintiff and the Ohio court of appeals affirmed holding that the lower landowner owes a servitude to the upper owner to receive the water that naturally flows from it. The upper owner has, although he cannot artificially change it to the damage of the lower owner, a natural easement in the lower property to the extent of the natural flow. The upper owner may in his reasonable use drain the surface water into its natural outlet. The plaintiff had the right to drain his land into a natural channel, and to accelerate the flow, as long as he did not drain water which would not have flowed there. The flow to defendant's land was not appreciably increased, and he had no right to impede the flow coming from the upper land. (Duss-Florida)
W70-07600

DWYER V VILLAGE OF GLEN ELLYN (ACTION FOR DAMAGES FOR THE FLOODING OF PLAINTIFF'S LANDS).

41 NE2d 786 (Ill Ct App 1942)

Descriptors: *Illinois, *Cities, Drainage, *Diversion, Sewage, Judicial decisions, Legal aspects, Surface drainage, Tile drainage, Sewers, Drains, Waste water disposal, Drainage water, Municipal wastes, Watercourses (Legal), Competing uses, Damages, Flow, Flooding, Pipes, Snow, Runoff, Overflow, Paving, Flood damage.

An action was brought by plaintiff against defendant city for damages to plaintiff's premises due to the overflow of water diverted upon plaintiff's land. Defendant installed street sewers and paving, thus diverting waters from a natural watercourse upon defendant's dominant estate causing an acceleration of flow and flooding of plaintiff's land. The court held that a municipality having a dominant estate is entitled to drain excess waters from its lands through natural drains on a servient estate. The quantity of water may be increased so long as sewage is not cast upon the servient lands. However, the municipality had no right to divert surface waters or the flow of watercourses from their natural channel into sewers or drains as in the instant case, without compensating the servient proprietor for damages resulting from the overflow. (Barnett-Florida)
W70-07601

CENTRAL INDIANA COAL CO V GOODMAN (ACTION FOR DAMAGES FOR THE WRONGFUL FLOODING OF PLAINTIFF'S LAND).
39 NE2d 484-487 (Ind Ct App 1942).

Descriptors: *Indiana, *Water pollution, *Drainage, *Mine water, Strip mine wastes, Judicial decisions, Legal aspects, Water pollution sources, Acid mine water, Coal mine wastes, Mine acids, Damages, Acid streams, Coal mines, Salts, Mineral water, Chemical properties, Acidity, Odor, Industrial wastes, Relative rights.

Plaintiff owned lands adjacent to defendant's mining operations. A drainage ditch was used to drain excess surface waters from plaintiff's land. Defendant, in the course of its mining operations, caused polluted, acidic mine water to be exposed and

discharged across plaintiff's land. Plaintiff brought action to recover for damages which resulted from this discharge. The court found that the mine water was something potentially damaging if it escaped from defendant's lands, consequently defendant was answerable for all damage which was the natural consequence of its escape. Although plaintiff's land was servient to the flow of surface water from defendant's land, it was not servient to waters contaminated by defendant's acts and cast upon plaintiff's lands through artificial channels. If an upper landowner alters natural conditions so as to change the course of the water or by artificial means increases its volume, he becomes liable for any injury caused thereby. (Barnett-Florida)
W70-07602

AKARD V CITY OF SHREVEPORT (DETERMINATION OF RIPARIAN OWNERS' RIGHTS TO ACCRETION).
200 So 14-16 (La 1941).

Descriptors: *Louisiana, *Accretion (Legal aspects), *Boundaries (Property), *Land tenure, Real property, Water law, Bayous, Gulf coastal plain, Streams, Deltas, Riparian rights, Riparian land, Banks, Judicial decisions, Boundary disputes, Legal aspects, Relative rights.

Plaintiff's father had conveyed to defendant, the City of Shreveport, a triangular tract of land along a bayou. He retained two adjoining lots which plaintiff acquired. Subsequent to the conveyance to the city, an accretion was created in the river along the tracts owned by defendant and plaintiff. Plaintiff brought suit to determine ownership of the alluvion. The court held that the alluvion was to be divided between plaintiff and defendant. When an alluvion is formed in front of riparian property, division is made according to the extent of the front line of each at the time of the formation of the alluvion. Each riparian proprietor acquires such proportion of the alluvial soil as the total extent of his front line bears to the total quantity of the alluvial soil to be divided. (Hubener-Florida)
W70-07606

AMERICAN AGRICULTURAL CHEMICAL CO V COBB (LIABILITY FOR RUPTURED RESERVOIR).
15 So 2d 188-189 (Fla 1943).

Descriptors: *Florida, *Reservoirs, *Flood damage, *Dam failure, Judicial decisions, Flooding, Impoundments, Standing waters, Surface waters, Detention reservoirs, Reservoir leakage, Seepage, Reservoir storage, Settling basins, Overflow, Dam construction, Rupturing, Earthworks, Relative rights, Legal aspects.
Identifiers: Negligence.

Defendant constructed an artificial reservoir or settling basin for the storage of water on land adjacent to plaintiff's property. The dam which held the reservoir broke and caused water, mud and silt to flow onto plaintiff's property. Plaintiff brought action to recover damages, alleging such damages were caused by defendant's negligent construction of the dam. The Florida Supreme Court affirmed the trial court's judgement for plaintiffs, holding that the evidence was sufficient to support a verdict based on negligence. (Douberley-Florida)
W70-07608

AMERICAN SAND AND GRAVEL CO V RUSHING (STREAM BANK EROSION CAUSED BY EXCAVATION ON LOWER RIPARIAN LAND).

184 So 60-63 (Miss 1938).

Descriptors: *Mississippi, *Reasonable use, *Bank erosion, *Flow rates, Mining, Natural streams, Excavation, Relative rights, Legal aspects, Judicial decisions, Water law, Gravels, Soil erosion, Channel erosion, Slopes, Bank stability, Streamflow, Valleys, Accelerated erosion, Flow, Riparian rights, Banks.

Plaintiff owned a tract of land through which ran a stream with many bends and irregular channels. Defendant was a lower, adjoining riparian owner who mined gravel from the stream banks. The defendant's mining operation eventually created a lake which had the effect of increasing the speed of stream flow across the upper land. The banks of the stream on plaintiff's land eroded and caved in over a wide area. In a suit for damages, the court held for defendant. The court stated that neither an upper nor lower riparian owner may make unreasonable use of his land or a stream, but that defendant's operations were reasonable. The court further held that an upper or riparian owner may improve or reclaim his lands by straightening, widening, or deepening the channel of a natural watercourse, even though such improvement causes an increase in the volume and speed of streamflow over abutting lands. Defendant was entitled to this right while engaged in straightening the stream in his operations. (Hubener-Florida)
W70-07611

FOSTER V WEBSTER (PRESCRIPTIVE RIGHT TO OVERFLOW; STATUTE OF LIMITATIONS).
44 NYS2d 153-159 (Sp Ct 1943).

Descriptors: *New York, *Prescriptive rights, *Repulsion (Legal aspects), *Overflow, Diversion, Adjudication procedure, Community development, Easements, Highway beautification, Judicial decisions, Legal aspects, Local governments, Natural flow doctrine, Proprietary power, Public rights, Remedies, Riddance (Legal aspects), Alteration of flow, Diversion structures, Relative rights, Surface runoff, Drainage.
Identifiers: *Statute of limitations.

Defendant superintendent of highways for many years had maintained drainage and diversion ditches parallel to a road running adjacent to plaintiff's land. The ditches caused surface water to flow onto plaintiff's land. Such flowage continued over the years uncontested until the time of this suit wherein plaintiff sought to enjoin defendant from clearing the ditches, which plaintiff had filled. The diverted surface water had apparently begun to erode plaintiff's land. The court held that a municipality may acquire a prescriptive right to divert surface water onto a private person's land, and that the evidence indicated that the statutory period of 15 years of hostile and uninterrupted use had been exceeded. The prescriptive period, however, constituted a statute of limitations and as such could be availed of only if pleaded. A statute of limitations operates only as a bar to a remedy, and, if not pleaded, must be considered waived. Defendant's answer contained no such plea; therefore, the prescriptive right defense could not be considered. Plaintiff's injunction was granted. (Clarke-Florida)
W70-07614

ACQUISITION BY ADVERSE POSSESSION OR USE OF PUBLIC PROPERTY HELD BY MUNICIPAL CORPORATION OR OTHER GOVERNMENTAL UNIT OTHERWISE THAN FOR STREETS, ALLEYS, PARKS OR COMMON.

Annot, 55 ALR2d 554-638 (1957).

Descriptors: *Federal government, *Local governments, *Prescriptive rights, *State governments, Cities, Boundaries (Property), Easements, Legal aspects, Islands, Tidal waters, Legislation, Low water mark, High water mark, Accretion (Legal aspects), Ownership of beds, Patents, Riparian rights, Riparian land, Riprap, Embankments, Relative rights, Navigation, Obstruction to flow, Engineering structures.

The general purpose of this annotation is to consider whether title by adverse possession, or acquisition of an interest less than a title in fee, can be acquired as against federal, state and municipal sovereignties. In the absence of express statutory permission, public lands of the United States cannot be obtained by adverse possession or prescription. Cases annotated have specifically applied this rule with regard to tidelands, accreted land, forest lands, school lands, swamplands and Indian lands. The same general rule applies with regard to property held by the state as to that held by the federal government. Constitutional and statutory provisions applicable to adverse possession, as construed, are examined herein. The same general rules not allowing adverse possession to run against the state and federal governments apply with equal force to land held for public use by a municipality, county or other minor political unit, but not so for lands held alienable and of a proprietary nature. Adverse possession does run against a governmental agency e.g., a drainage district, even when it does not run against the state. (Barnett-Florida)
W70-07615

DRAINAGE–SANITARY DISTRICTS (STRUCTURE, FORMATION AND ADMINISTRATION).
For primary bibliographic entry see Field 04A.
W70-07618

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE OF THE REPORT BY THE COMMISSION ON MARINE SCIENCE, ENGINEERING AND RESOURCES).
Natural Resources Lawyer, Vol 2, No 4, p 412-441, Nov 1969. 30 p, 17 ref.

Descriptors: *Resource development, *Continental shelf, *Marine geology, *Exploitation, Legal aspects, Political aspects, United Nations, Sea water, Oceans, Organizations, Administrative agencies, Continental margin, Mineralogy, Geological surveys, International law, International waters, Treaties, Coasts, Federal government, Oil, Exploration, Technology, Natural gas, Fresh water, Beds.

A critique of a portion of the Report by the Commission on Marine Science, Engineering and Resources, this article deals with non-living marine resources beneath the sea and emphasizes the legal and institutional aspects of the Commission's Report. Two principal subject headings are: (1) the development of non-living marine resources and (2) an international legal-political framework for exploring and exploiting seabed mineral resources. Included under the first heading are considerations of petroleum, natural gas, hard minerals, fresh water, and pre-investment geological surveys. Under the second heading the critique considers international objectives regarding mineral resources, the existing international framework, the Treaty of the Continental Shelf, the regime behind the treaty shelf, relations between government and private enterprise, and a suggested course of interim action before establishment of a new framework. An appendix to the critique contains a resolution prepared by the American Bar Association. (See also W70-07625 thru W70-07627). (Duss-Florida)
W70-07624

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE: THE DEVELOPMENT OF NON-LIVING MARINE RESOURCES).
Natural Resources Lawyer, Vol 2, No 4, p 413-418, Nov 1969. 6 p, 2 ref.

Descriptors: *Resource development, *Exploitation, *Marine geology, *Continental shelf, Legal aspects, Administrative agencies, Federal government, Oil, Mineralogy, Natural gas, Mining, Fresh water, Pipelines, Technology, Planning, Management, Geological surveys, Costs, Investment, Exploration, Sea water, Coasts, Leases, Industries.

The Report of the Marine Science Commission divides non-living marine resources into four categories: oil, gas, hard minerals and fresh water. The Report notes the significance of offshore oil development, the need for exchange of technical information regarding this source, and the need for United States leasing and regulatory policies to

reflect all aspects of national interests. This critique agrees generally with the Report but would include all mineral industries in the exchange of technical information and would give private industry a greater voice in decision making. The Report makes several constructive suggestions designed to encourage exploration and development of offshore natural gas. The suggestions relate to the regulation of pipelines by the Federal Power Commission. Regarding hard minerals, the Report notes the relative infancy of ocean mining, the high costs of exploitation, the need for technological development, and the necessity for state and federal incentives to encourage exploration and development. One major incentive would be to award development rights on the outer continental shelf without requiring competitive bidding. Concerning fresh water, the Report recommends continued efforts by the Department of the Interior in the area of desalination. This critique cites the need for cooperation between government and private industry in desalination, but generally agrees with the Commission's report. (See also W70-07624). (Duss-Florida)
W70-07625

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE: INTERNATIONAL LEGAL-POLITICAL FRAMEWORK FOR SEABED MINERAL RESOURCES).
Natural Resources Lawyer, Vol 2, No 4, p 418-430, Nov 1969. 13 p, 10 ref.

Descriptors: *International law, *Exploitation, *Continental shelf, *Treaties, Resource development, Legal aspects, Sea water, Continental margin, Continental slope, Technology, Exploration, Mineralogy, International waters, Natural resources, Subsoil, Marine geology, Beds, Coasts, Federal government, International commissions, Boundaries (Property), Research and development.

The Report of the Marine Science Commission takes the position that the existing international framework for exploitation of seabed mineral resources is inadequate. The present regime is based on the Convention on the Continental Shelf which is deficient in that it deters development of mineral resources. Development is discouraged because: (1) there is an uncertainty as to the seaward boundary of the continental shelf; and (2) beyond the boundary line existing principles are insufficient to assure security and protect national and international interests. To improve this situation the Report urges that the United States initiate a new international agreement to redefine the continental shelf and to provide more definite areas of control. This Critique of the Report disagrees with the Commission's position. While finding it laudable to encourage scientific and technical research, secure the rights of all nations to resource development, and avoid international conflict, it does not agree that the existing Convention is too vague in defining the limits of the continental shelf. The Critique finds that the concept of adjacency in defining the limits of the continental shelf best promotes United States interests. Moreover, its possible extensiveness is an asset since a new international agreement is unlikely. A formal international agreement is not preferable anyway as agreement could be achieved by parallel declarations of interested states announcing a uniform interpretation of the existing Convention agreement. (See also W70-07624). (Duss-Florida)
W70-07626

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE: INTERNATIONAL LEGAL-POLITICAL FRAMEWORK FOR SEABED MINERAL RESOURCES), INTERNATIONAL REGISTRY AUTHORITY AND CONCLUSIONS.
Natural Resources Lawyer, Vol 2, No 4, p 430-441, Nov 1969. 12 p, 4 ref.

Descriptors: *International law, *Exploitation, *Continental shelf, *International commissions, Resource development, Legal aspects, Oceans, Sea water, Continental margin, Continental slope, Technology, Exploration, Mineralogy, United Nations, Investment, Administrative agencies, Costs, United States, Natural resources, Beds, Coasts, Boundaries (Property), Marine geology, Federal government.

The Report of the Marine Science Commission proposes: (1) the creation of an international registry authority to register nations' claims for exploration and exploitation of the continental shelf; and (2) an international fund to collect revenue derived from exploitation of resources. The Report also sets forth: (1) the powers and duties of registering states; (2) the policing functions of the registry authority; (3) procedures for the settlement of disputes; and (4) proposals for the creation of an intermediate zone for exploitation beyond the shelf limit. The registry authority would be a part of the United Nations but would be autonomous. This Critique of the Report is generally favorable to these suggestions. However, it would alter some of the procedures for registering claims, insulate the authority from control by the General Assembly, restrict the authority's right to fix payment to the international fund, and would curtail creation of an intermediate zone. The Critique also contains recommendations concerning creation of a deep sea international regime. Regarding the United States specifically, the Commission Report recommends that the Department of Interior register domestic claims. The Critique agrees with this in principle. (See also W70-07624). (Duss-Florida)
W70-07627

APPLICATION OF FORD (ASSIGNMENT OF EMINENT DOMAIN COMPENSATION).
304 NYS2d 773-778 (1969).

Descriptors: *New York, *Administrative agencies, *Condemnation, *Eminent domain, Judicial decisions, Legal aspects, Riparian rights, Diversion, Remedies, Impoundments, State governments, Water supply, Delaware River, Tributaries, Administration, Adjudication procedure, State jurisdiction, Planning, Water delivery, Water demand, Water management (Applied), Water shortage.

Pursuant to statute in 1952, New York City, under eminent domain powers, obtained the right to divert the waters of the Neversink River and obtained certain lands necessary for this purpose. Subsequent to this date, and before compensation by the City, an owner of such lands appropriate by the city in 1952, conveyed title to grantee-claimants in this action. No assignment of the grantor's claim for compensation against the city was given. Upon the grantor's death his estate sought damages for the lands appropriated in 1952. The grantees by the subsequent conveyance sought to intervene by motion. The issue to be resolved was whether the fee vested in the City prior to the owner's conveyance to grantees. If so, the grantee's allegations were groundless as the owner had no title to convey and had made no assignment of the claim. The court held that failure to adhere to procedural technicalities in the New York Water Supply Act in appropriating the property in 1952 were insignificant and in no way defeated the city's title taken pursuant to that Act. The grantee's motion was denied. (Barnett-Florida)
W70-07628

MATTHEWS V BAGNIK (RIPARIAN RIGHTS IN NONNAVIGABLE LAKES).
41 A2d 875-878 (Penn 1945).

Descriptors: *Pennsylvania, *Boundary disputes, *Ownership of beds, *Non-navigable waters, Judicial decisions, Riparian rights, Water rights, Banks, Prescriptive rights, Relative rights, Riparian land, Riparian waters, Boundaries (Property), Lakes, Ponds, Lake beds, Beds under water, Fishing, Real property, Easements, Legal aspects.

Plaintiff owned a tract of land bounded on one side by a non-navigable private lake. Plaintiff asserted ownership of certain portions of the lake by prescription and alleged riparian rights to the center of the lake. The court found that the deed described the land by natural boundaries, and since the lake was named as a boundary plaintiff had no right to claim property beyond the shore line. The court held that in the case of a non-navigable lake, where the land covered by water is owned by others and no riparian rights attach to the property bordering on the lake, an attempt to exercise such rights is a trespass as if on dry land. Ownership of land bordering the lake did not give any rights of ownership in the lake itself. The court further held that plaintiff gained no rights by prescription. The rights of the owners of the lake had been asserted against the trespass of plaintiff numerous times. The fact that plaintiff did enter the lake to fish did not give plaintiff title or an easement thereto. (Douberley-Florida)
W70-07634

FRAZIER V SHANTZ REAL ESTATE AND INVESTMENT CO (TITLE TO ALLEGED ACCRETION).
123 SW2d 124-133 (Mo 1938).

Descriptors: *Missouri, *Boundaries (Property), *Accretion (Legal aspects), *Boundary disputes, Surveys, Judicial decisions, Legal aspects, Relative rights, Riparian rights, Water law, Rivers, Water rights, Land forming, Real property.

Plaintiff brought actions of ejectment and to quiet title against defendant, an adjacent landowner. The land in controversy bordered the Meramec River. Defendant claimed title to the land as an accretion to riparian land patented to his predecessor in title. The east-west center line of the survey section formed the common boundary of the parties' adjoining lots. From the original government survey it was unclear in which half of the survey section the river was located. All conveyances in plaintiff's chain of title purported to convey all land north of the Meramec River in the south half of the survey section. The court could not determine whether accretions had, in fact, formed. Therefore title to the land in controversy was adjudged to be in plaintiff. (Cuevas-Florida)
W70-07636

GOODLOE V CITY OF RICHMOND (PRIVATE WATER RIGHTS).
113 SW2d 834-838 (Ky 1937).

Descriptors: *Kentucky, *Easements, *Water contracts, *Water supply, Water allocation (Policy), Legal aspects, Boundaries (Property), Contracts, Judicial decisions, Local governments, Preferences (Water rights), Public rights, Resource allocation, Social needs, Water rights, Well permits, Supply contracts, Water quality, Relative rights, Prescriptive rights, Public lands.

During a severe water drought, plaintiff laid a water pipe line across two city streets from a well to his garage and pumped water through it to supply the needs of his business. The city of Richmond and the water company joined in a suit against plaintiff to enjoin him from further use of the pipe line. The trial court held that because of the water shortage and defendant water company's failure to furnish an adequate supply, plaintiff could continue to use the water line as long as the emergency existed. Two years later, after the drought had ended, the city severed the pipe line. Plaintiff sued the city for injunctive relief and damages, and he sued the water company for alleged damages arising from breach of a contract wherein the water company promised to purchase water from plaintiff's well in excess of his needs, provided that the water met the approval of the state Board of Health. The court held in the first instance that the plaintiff's invasion of the streets was in fact a trespass abinitio and that the lower court's initial refusal to compel plaintiff to cease using the pipe line was purely a matter of

grace. Plaintiff's only injury by defendant water company consisted of defendant's failure to supply a sufficient quantity of water for plaintiff's business needs, and damages arising therefrom were never proved. Plaintiff's personal contract with defendant water company never became operative because well water was never approved by the state Board of Health. (Clarke-Florida)
W70-07638

BLAIN V CRAIGIE (RESERVATION OF RIPARIAN RIGHTS).
293 NW 745-747 (Mich 1940).

Descriptors: *Michigan, *Riparian rights, *Riparian land, *Docks, Judicial decisions, Artificial use, Banks, Ownership of beds, Reasonable use, Recreation, Relative rights, Remedies, Riparian waters, Water law, Legal aspects, Water utilization, Land tenure, Boundaries (Property), Lakes.

Lands on a lake, including 30 feet of property extending from the low-water mark of the lake, were deeded to defendants. There were no specific reservations of riparian rights by the conveyor. Defendants erected a hotel on the property and constructed a dock extending 108 feet into the lake. Plaintiff, son of the conveyor, contended that recreational activity connected with the dock interfered with his use of an island lying 700 feet from the shore. Plaintiff claimed that extension of the dock further than 30 feet constituted trespass, and he sought removal of that portion of the dock. The court held that conveyance of property bounded by a watercourse carries with it, in the absence of a reservation, the riparian rights. A reservation of riparian rights is not presumed. The conveyance of 30 feet of land into the lake was not a reservation of rights in the water beyond the 30 feet. (Dye-Florida)
W70-07641

HOLDA V GLICK (MISTAKE IN CONVEYANCE OF MILLPOND PROPERTY).
312 Mich 394, 20 NW2d 248-252 (Mich 1945).

Descriptors: *Michigan, *Ownership of beds, *Boundary disputes, *Land tenure, Riparian rights, Judicial decisions, Legal aspects, Water law, Beds, Beds under water, Boundaries (Property), Ponds, Real property, Land, Land reclamation, Land forming, Landfills, Relative rights, Ponds, Contracts.

Defendant, plaintiff's vendor, purchased property together with all rights in an adjacent millpond. Plaintiff purchased the property by a conveyance which failed to mention the millpond. Plaintiff and a corporation owning adjacent property filled portions of the millpond, creating usable land, and the remainder was subsequently drained. A dispute arose between plaintiff and the corporation as to ownership of the millpond land. Plaintiff sought reformation of the land contract with defendant on the grounds that defendant represented to plaintiff prior to the sale that the millpond was part of the property to be conveyed and that the pond was excluded from the deed by mutual mistake. Defendant denied that there was a mistake. The court held that, as the vendor did not reserve rights in the pond, they passed with title to the property. Nevertheless, reformation required plaintiff to prove mistake by clear and convincing evidence. Plaintiff failed to carry the burden of proof and reformation was denied. (Dye-Florida)
W70-07643

INHABITANTS OF HOLLISTON V HOLLISTON WATER CO (EXTENT OF WATER COMPANY'S EMINENT DOMAIN POWERS--DEFINITION OF STREAM AND SPRING).
27 NW2d 194-197 (Mass 1940).

Descriptors: *Massachusetts, *Streams, *Water works, *Eminent domain, Springs, Judicial decisions, Legislation, Administration, Cities, Real property, Domestic water, Running waters, Bodies of water, Confined water, Fresh water, Spring waters, Subsurface waters, Water sources, Water supply, Water wells, Groundwater, Pumping, Banks, Percolating waters, Legal aspects.

In a dispute between a municipality and a water company, the company claimed title to a tract of land by eminent domain. The court found that the water company's powers were limited by statute to taking land only if that land consisted of or contained a spring or a stream. The company used the land to drill a well from which water was brought to the surface by pumps. The court held that a stream implied a flow in an ascertainable direction between banks and within limits. Since the percolating waters were held not to be a stream, the land could not be said to contain a stream. The court held that a spring issued forth from the ground in such a manner as to disclose the presence of water upon the surface. Percolating water brought to the surface from beneath an impervious layer of clay with a pump was not a spring within the meaning of the statute. Since the land contained neither a stream nor a spring, the taking by the water company was held to be unlawful. (Douberley-Florida)
W70-07645

EARHART V ROSENWINKEL (PROPERTY LINE DISPUTE OVER LAND ADJACENT TO LAKE).
25 NE2d 268-273 (Ind Ct App 1940).

Descriptors: *Indiana, *Boundaries (Property), *Boundary disputes, *High water mark, Judicial decisions, Riparian rights, Real property, Lakes, Non-navigable waters, Bodies of water, Ownership of beds, Beds under water, Shores, Ponds, Water rights, Banks, Riparian land, Legal aspects, Relative rights.

In a suit to quiet title to land adjacent to a non-navigable lake, a dispute arose over a land description which used a section corner, an iron stake and willow tree, and the ordinary high water mark of the lake as starting points for a metes and bounds description. The court held that where the intent of the parties is not otherwise stated, there is a presumption that the grantee of land bounded by a non-navigable stream or river acquires land title to the center or thread of the water. The presumption was said to apply unless the contrary clearly appears or is necessarily implied, and would have applied in this case if artificial monuments had not been used in the description. The court stated that natural monuments take precedence over inconsistent artificial monuments in the description. Further, it was presumed that when monuments are mentioned in the deed as occupying the bank of a river, the lines should be continued to the water's edge, even if that is beyond the monument itself. The court held that the description in the deed carried the title, with riparian rights, at least to the water line of the lake. (Douberley-Florida)
W70-07646

DALE V BEDAL (IMPLIED EASEMENT FOR SEWAGE DISPOSAL).
25 NE2d 175-176 (Mass 1940).

Descriptors: *Massachusetts, *Easements, *Septic tanks, *Subsurface drainage, Judicial decisions, Contracts, Real property, Land use, Disposal, Sewage disposal, Soil disposal fields, Waste disposal, Conduits, Sewers, Closed conduits, Outlets, Pipes, Drainage, Prescriptive rights, Legal aspects.

Plaintiff had owned two adjacent parcels of land, and the sewage from plaintiff's house was piped to a reception tank on the other parcel. Defendant purchased the latter parcel from plaintiff without knowledge of the tank or the pipeline. Plaintiff sought to establish a right by necessity to maintain and use the underground receptacle on defendant's land. The court found that there may be an easement of drainage by necessity, but that implied easements do not arise out of necessity alone. Since neither plaintiff nor the physical situation of the premises gave notice to defendant of the existence and use of the tank, the court held that an easement would not be implied from the terms of the conveyance. Implied terms could not be imported into the conveyance because of the needs of one of the parties of which the other party had neither knowledge nor notice. Plaintiff's action was denied. (Douberley-Florida)
W70-07647

HARRISON V POLI-NEW ENGLAND THEATRES, INC (LIABILITY FOR ICE IN FRONT OF BUSINESS).
23 NE2d 99-101 (Mass 1939).

Descriptors: *Massachusetts, *Ice, *Buildings, *Drains, Judicial decisions, Snow, Highway icing, Freezing, Land development, Land use, Landscaping, Structures, Roofs, Runoff, Surface runoff, Discharge (Water), Snowmelt, Surface waters, Natural flow, Channels, Drainage effects, Repulsion (Legal aspects), Riddance (Legal aspects).

Plaintiff slipped on ice on the sidewalk in front of defendant's place of business and sued for damages. Plaintiff alleged that the ice was formed from water dripping from defendant's marquee. The court stated that a landowner has the right to construct buildings on his property even if the natural course of surface water is changed, but he had no right to collect surface water into an artificial channel and discharge it upon the way in a greater quantity than would have been discharged but for the building. The court affirmed the jury's finding that defendant was negligent in maintaining a defective marquee from which water dripped and froze upon the sidewalk. (Douberley-Florida)
W70-07648

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION, ST. CHARLES RIVER, PUEBLO, COLORADO.
Corps of Engineers, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04A.
W70-07161

FLOOD PLAIN INFORMATION, MINGO CREEK, TULSA, OKLAHOMA.
Corps of Engineers, Tulsa, Okla.
For primary bibliographic entry see Field 04A.
W70-07162

RIVER FORECASTING TECHNIQUES IN KOREA,
Ministry of Construction, Seoul (South Korea).
For primary bibliographic entry see Field 02E.
W70-07176

FLOOD PLAIN INFORMATION, PENNSAUKEN CREEK AND SOUTH BRANCH, BURLINGTON AND CAMDEN COUNTIES, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W70-07192

FLOOD PLAIN INFORMATION, LITTLE LA GRUE BAYOU, HOLT QUERTERMOUS AND PRICE BRANCHES, DEWITT, ARKANSAS.
Corps of Engineers, Memphis, Tenn.
For primary bibliographic entry see Field 04A.
W70-07194

MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, CASSVILLE, WISCONSIN.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-07197

FLOOD PLAIN INFORMATION, WABASH RIVER AND WILDCAT CREEK, VICINITY OF LAFAYETTE AND WEST LAFAYETTE, TIPPECANOE COUNTY, INDIANA.
Corps of Engineers, Louisville, Ky.
For primary bibliographic entry see Field 04A.
W70-07212

FLOOD PLAIN INFORMATION, DAN AND SANDY RIVERS AND SANDY CREEK, DANVILLE, VIRGINIA.
Corps of Engineers, Wilmington, N.C.
For primary bibliographic entry see Field 04A.
W70-07347

FLOOD PLAIN INFORMATION, CEDAR RIVER AND TRIBUTARIES, AUSTIN, MINNESOTA.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-07372

FLOOD PLAIN INFORMATION, ROCK RIVER, WINNEBAGO, ILLINOIS.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-07373

SPECIAL FLOOD HAZARD INFORMATION REPORT, BARTON CREEK, AUSTIN, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 04A.
W70-07374

THE TECHNICAL SERVICES DESIGN PROBLEM,
Northwestern Univ., Evanston, Ill.
Kenneth J. Cypra.
In: Technical Services for Urban Flood Plain Property Models: Problem Formulation and Study of Property Manager Receptivity, Evanston, Illinois, Chapter I, PhD dissertation, 1970, p 1-28. 1 fig, 1 tab, 10 ref.

Descriptors: *Non-structural alternatives, *Communication, *Community development, *Education, *Flooding, *Flood plain zoning, *Floodproofing, *Flood protection, *Political aspects, Local governments, Federal government, State governments, Flood plain insurance, Abatement, Design criteria, Design, Tennessee Valley Authority Project, Regions, Decision making, Planning, Programs, Legal aspects.
Identifiers: *Flood plain managers, *Flood plain management, *Property managers, *Homeowners, *Technical services program, *Technical service, *Technical assistance, *Efficacy, *Expectation, *Information, *Flood hazard, *Proper use, *Receptivity, *Compliance, Flood warnings, Implementation, Alternatives.

This chapter treats the technical services design problem for flood plain managers. Flood plain managers are defined as property owners of flood plain lands. The chapter is concerned with two main topics: the programmatic framework; and major design factors. The services are characterized as education, information and technical assistance, and aim toward 'proper use' of the flood plain. 'Proper use', defined as a combination of community goals, individual goals and the local flood hazard, is the basis for the local flood plain management (FPM) effort. In designing a technical services program to fit the FPM effort, three objectives are identified: fostering hazard awareness; encouraging efficacy for property manager action; and complementing a program of public control and regulation by facilitating property manager compliance. A table of selected properties of technical service alternatives relate these objectives to the service possibilities. Two design criteria are considered: the overall FPM effort; and receptivity of individual property managers. The overall FPM effort might range from no legal restrainists to total regulation. Different alternatives would be needed accordingly. Receptivity depends greatly on perception of flood hazard and efficacy. This can be effected by the dissemination of relevant services which are both timely and effectively communicated. (Richmond-Chicago)
W70-07547

6G. Ecologic Impact of Water Development

A BIBLIOGRAPHY OF BOOKS ON THE ENVIRONMENT -- AIR, WATER AND SOLID WASTES,
Toledo Univ., Ohio. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 10.
W70-07190

07. RESOURCES DATA

7A. Network Design

THE ACQUISITION OF DATA FOR FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 02E.
W70-07173

THE REPRESENTATIVE BASIN CONCEPT IN AUSTRALIA.
Australian Water Resources Council, Canberra.

Australian Water Resources Council Hydrological Series No 2, 1969. 24 p, 5 fig, 1 map, 1 tab, 19 ref, append.

Descriptors: *Rainfall-runoff relationships, *Stream gages, *Mathematical models, *Rainfall disposition, Topography, Geology, Land use, Vegetation effects, Parametric hydrology, Hydrogeology, Hydrologic data, Unit hydrographs, Hydrograph analysis.
Identifiers: *Australia, Representative basins.

In order to supplement the accelerated stream gaging program which is currently being carried out by the State and Commonwealth Governments, the Australian Water Resources Council has initiated a program of selection, instrumentation and operation of nearly a hundred representative basins throughout Australia. The objectives are to provide a better basis for estimation of runoff in ungaged catchments, and a better understanding of the hydrological cycle in general. The basis for selection of the basins, and proposals for the collection and analysis of data from them are outlined. To provide an objective and scientific basis for the selection of the representative basins, a map of Australia showing 'Relief and Land Form' was compiled, and on this the boundaries of 11 broad climatic zones, based on the amount and seasonal distribution of rainfall, were superimposed. On this basis it appeared that a total of 93 catchments would be expected to provide data that would be broadly representative of the whole of Australia. (Knapp-USGS)
W70-07191

DISTRIBUTION OF A HYDROLOGIC NETWORK IN IRRIGATED AND DRAINED AREAS,
K. S. Kabanova.
Transl. from Trudy Gos Gidro Instituta, No 164, p 56-63, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 594-600, 1968. 1 fig, 2 tab, 2 ref.

Descriptors: *Hydrologic data, *Data collections, *Network design, Runoff, Irrigated land, Drainage districts, Rivers, Discharge (Water), Stations, Hydraulic structures.
Identifiers: *USSR, Zeravshan River, Pripyat' River.

Placement of runoff stations along the length of a river must allow determination of runoff in individual reaches. Variation in water discharge along the river course can result from natural or artificial modifications of the environments. The distribution of hydrologic stations along the Zeravshan River, USSR is described. Large water quantities from this river are used for irrigation. Distribution of a hydrologic network in a large drainage basin must consider: (1) use of all possible stations with long series of observations; (2) determination of runoff; (3) study of water regime in reaches above and below dams and other hydraulic structures; (4) water balance determination in reservoir areas based on hydrometric data. An analysis of the existing hydrologic network in the Pripyat' River basin showed that the number of stations should be increased by 40%. (Carstea-USGS)
W70-07198

PRINCIPLES FOR THE DISTRIBUTION OF INFORMATION HYDROLOGIC POSTS,
R. A. Shestakova.
Transl. from Trudy Gos. Gidrol Instituta, No 164, p 49-55, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 588-593, 1968. 2 fig, 1 tab, 9 ref.

Descriptors: *Runoff forecasting, *Streamflow forecasting, *Network design, Gaging stations, Rivers, Correlation analysis, Flow, Tributaries.
Identifiers: *USSR, Dnieper River, Oka River, Sula River, Vilyny River, Kiev.

Runoff forecasting for small rivers is important for planning and operating hydroelectric power stations. Forecasting spring runoff on the Dnieper River at Kiev uses multiple correlation methods for forecasting the water flow at the outlet stations. The optimum catchment area of small rivers differs for different hydrologic stations and depends on the catchment area of the outlet station, water regime, nature of the predicted element, and computation time interval. It is recommended that: (1) a correlation analysis be made in order to select the minimum number of stations; and (2) hydrometric stations be planned on tributaries with a relative catchment area obtained from an analysis of data for rivers situated in different physiographic regions. (Carstea-USGS)
W70-07199

PRINCIPLES FOR DISTRIBUTION AND PROSPECTS FOR DEVELOPMENT OF A HYDROLOGIC NETWORK,
I. F. Karasev.
Transl. from Trudy Gos Gidrol Institute No 164, p 3-36, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 560-588, 1968. 3 fig, 2 tab, 23 ref.

Descriptors: *Hydrologic data, *Data collections, *Network design, Stations, Runoff, Lakes, Reservoirs, Water levels, Rivers, Forecasting.
Identifiers: *USSR.

The present status of the hydrologic network of the USSR and proposals for its development based on modern concepts of hydrologic processes are discussed. The existing network consists of about 6500 runoff stations. In addition, stations for measuring lake and reservoir water levels increase the overall number of stations to 8300. The number of stations in the European USSR is close to an optimum, although a redistribution may be desirable. A sequence for establishing an optimum hydrologic network is discussed. In the first stage (1967-1972) about 1060 new stations are to be established, and in the second stage (1973-1982) another 1230 stations are planned. (Carstea-USGS)
W70-07205

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

HYDROLOGIC INVESTIGATIONS,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
L. B. Davies.
Engineering Journal (Canada), Vol 52, No 10, p. 48-56, Oct 1969. 9 p, 9 fig, 1 tab, 6 ref.

Descriptors: *Hydrology, *Hydrologic data, *Investigations, Snowmelt, Streamflow, Field investigations, Foreign projects, Hydrometeorological station, Mass curves, Storage capacity, Runoff, Reservoirs, Flood peaks, Project planning, Gaging stations, Flood routing, Spillway design flood.
Identifiers: *Portage Mountain Dam, *Portage Mountain Powerplant, Canada, W A C Bennett Dam (Canada), Canada, Flood hydrology.

The design of the Portage Mountain Development in Canada involved extensive studies of the hydrology of a 27,000-sq-mi drainage basin. A hydrometeorological network comprising snow courses, streamflow gages, and meteorological stations was set up to collect data used to determine a spillway design flood, reservoir filling curves, and firm energy outputs. Other determinations to be made included: (1) the average runoff and the probable variation in runoff over the life of the project, based on the historic records of the Peace River at Hudson Hope and of adjacent streams; (2) the storage volume of the reservoir created by the construction of W A C Bennett Dam; (3) the annual variation of runoff from snowmelt and precipitation, leading to the development of forecasting methods; (4) the magnitude of floods of critically great volume leading to the design of a spillway large enough to permit the passing of these floods without causing reservoir levels to rise beyond the maximum elevation permitted for safety; and (5) economic use of the water power. (USBR)
W70-07426

7B. Data Acquisition

SOME COMMENTS ON REFLECTANCE MEASUREMENTS OF WET SOILS,
National Environmental Satellite Center, Washington, D.C. Satellite Experiment Lab.
Walter G. Planet.
Remote Sensing of Environment, Vol 1, No 2, p 127-129, March 1970. 3 p, 3 fig, 1 tab, 5 ref.

Descriptors: *Remote sensing, *Soil moisture, *Optical properties, Light, Refractivity, Heat balance.
Identifiers: Soil moisture sensing.

The observed visual darkening of wet natural soils is ascribed to total internal reflections of the reflected radiation in a water layer covering the soil. If the index of refraction of the liquid and the reflectance of the sample when dry are known, it is possible in principle to predict the visual reflectance of a saturated soil sample. Laboratory measurements were performed to evaluate this; samples of varying reflectance and liquids of different indices of refraction were used. The results support the explanation and indicate conditions where it should be used with caution. (Knapp-USGS)
W70-07155

SNOWFIELD MAPPING WITH K-BAND RADAR,
Kansas Univ., Lawrence. Remote Sensing Lab.
William P. Waite, and Harold C. MacDonald.
Remote Sensing of Environment, Vol 1, No 2, p 143-150, March 1970. 8 p, 10 fig, 1 tab, 13 ref.

Descriptors: *Remote sensing, *Snowpacks, *Snow Surveys, *Radar, Snow cover, Surveys, Investigations, Instrumentation, Glaciers, Ice.
Identifiers: K-band radar.

Analysis of K-band imagery from several snowfield areas in the United States suggests that the distribution of perennial snow results in an anomalously high return. In contrast to normal snow survey methods, it appears feasible to map the areal extent of old snow areas irrespective of most weather conditions, and even when covered with new-fallen snow. The observed differences in signal return between the metamorphosed snow and the surrounding terrain do not seem explainable simply by moisture content. It is suggested that the significant increase in signal return of old snow arises from volume scattering. The structure of the metamorphosed snow plays a much more important role than affecting the form factor of the dielectric mix of ice and air. A considerably more complex model must be assumed for the interpretation of microwave return from snowfields. (Kanpp-USGS)
W70-07157

PHOTOGRAPHIC MONITORING OF SHORELINE MOVEMENT,
Corps of Engineers, Wilmington, N.C.
John D. Weber.
Shore and Beach, Vol 38, No 2, p 36-38, April 1970. 3 p, 1 fig.

Descriptors: *Beach erosion, *Sediment transport, *Aerial photography, Remote sensing, Photogrammetry, Dunes, High water mark, Coasts, Geomorphology, Shores.
Identifiers: Shoreline movement.

A study was conducted at the U.S. Army Engineer District, Wilmington, N.C., South Atlantic Division, to determine the feasibility of developing a system of monitoring shoreline movements through the use of aerial photography. A unique monitoring process is based on comparing the distances from fixed reference points to index points on the beach taken from separate sets of aerial photographs. This type of system was found to be feasible only if an index point on the photo which represents the actual location of the beach at the time of photography can be located. There are usually three index points available on a typical beach profile: The seaward toe of the dune system called the dune line; the maximum extent of wave run-up (called the high-water line); and the land-water boundary (called the water line). The dune line is an excellent indicator of beach migration and can provide valuable information in relation to the stability of a particular reach of shoreline. Because of the impracticability of considering the combined effect these factors would have on the location of the high water line, it was decided not to use the so-called high water line as an index point in developing the monitoring system. The water line, similar to the other index points discussed so far, is not ideal but appears to be the most practical and reliable point. The most important factors are to obtain the photography at a time and in such a manner as to eliminate as many of the variables as possible and to obtain the necessary field data immediately after the photography is taken. (Knapp-USGS)
W70-07164

DETERMINATION OF GROUNDWATER AGES BY THE TRITIUM -- 3 He METHOD,
Institute of Precambrian Geology and Geochronology, Leningrad (USSR); and All-Union Petroleum Geology Exploration Inst.
I. N. Tolstikhin, and I. L. Kamenskiy.
Transl. from Geokhimiya, No 8, p 1027-1029, 1969. Geochemistry International, Vol 1969, No 7-8, p 810-811, April 1970. 7 ref.

Descriptors: *Radioactive dating, *Tritium, *Helium, *Groundwater, Radioisotopes, Radiochemical analysis, Geochemistry, Groundwater movement.
Identifiers: Groundwater dating, USSR.

Determining the age of groundwaters from their tritium contents is difficult because of the large variations in the tritium content of precipitation. Tritium decays to He-3 and it is suggested that the He-3 accumulation in the water could be used to measure the decayed tritium, so the initial tritium content can be found. He-3/He-4 and He/Ne ratios could be used to correct for atmospheric He contributions, or detect He from older admixed waters. (Knapp-USGS)
W70-07168

SOME POTENTIAL APPLICATIONS OF METEOROLOGICAL SATELLITES IN FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
A. F. Rainbird.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 73-80, 1969. 8 p, 5 fig, 12 ref.

Descriptors: *Flood forecasting, *Data collections, *Satellites (Artificial), *Remote sensing, Synoptic analysis, Reviews, Surveys, Aerial photography, Infrared radiation, Meteorological data, Hydrologic data.
Identifiers: Meteorological satellites.

Meteorological satellites offer a number of advantages as observing platforms. They are able to view every point on Earth periodically; they make possible the rapid collection and read-out of data; and, whenever an element can be measured directly by satellite-mounted sensors, they eliminate the need to interpolate data between the point samples of conventional observing networks. (Knapp-USGS)
W70-07174

NEW ENRICHMENT AND MULTIPLE SAMPLING PROCEDURES TO INVESTIGATE RADIOACTIVE TRACER MIXING IN A SMALL RIVER,
Agricultural Research Council of Central Africa, Salisbury (Rhodesia).
P. R. B. Ward, and P. Wurzel.
Journal of Hydrology, Vol 6, p 265-276, 1968. 12 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Tracers, *Mixing, *Tracking techniques, *Radioactivity techniques, *Streamflow, Floats, Current meters, Instrumentation, Radioisotopes, Diffusion, Dispersion, Sampling, Solutes, Aqueous solutions.
Identifiers: Longitudinal dispersion.

Recent work in the measurement of flow in rivers and canals with radioactive tracers has stressed the importance of the use of many sampling points. A thorough investigation of the lateral distribution of the tracer at sampling stations is necessary. Invariably, it is the distance required for complete lateral dispersion of tracer which determines the mixing distance in natural streams. The use of floating samplers was found to be most satisfactory in an investigation of lateral mixing in a small stream. The small size of the samplers, 1000 ml, ensured that comprehensive investigations using many sampling points were undertaken without difficulties of handling after the experiment. A new method of concentration of radioisotopes using paper evaporation of the samples ensured that the tracer was counted with high detection sensitivity despite the small volume of samples. Accurate measurement of the tracer concentration as a function of time at two stations allowed the tracer passage curves to be reliably determined. Use of this data enabled the longitudinal dispersion coefficient to be calculated by two methods. (Knapp-USGS)
W70-07196

ARGON 37, ARGON 39, AND KRYPTON 81 IN THE ATMOSPHERE AND TRACER STUDIES BASED ON THESE ISOTOPES,
Bern Univ. (Switzerland). Physikalisches Institut.
For primary bibliographic entry see Field 02K.
W70-07248

RECENT RESEARCH TO DETERMINE REAERATION COEFFICIENT,
Institute of Hydrotechnical Research, Bucharest (Rumania).
M. Negulescu, and V. Rojanski.
Water Research, Vol 3, p 189-202, 1969. 11 fig, 3 tab, 14 ref.

Descriptors: *Streams, *Reaeration, *Biochemical oxygen demand, Oxygenation, Analytical techniques, Mathematical studies, Equations, Rivers.
Identifiers: *Reaeration coefficient, Stream hydraulics, Oxygen absorbtion, Oscillograms, O'-Connor-Dobbins equation, Krenkel-Orlob equation, Reynold's number.

Investigation was conducted in a 20- by 30-centimeter, 20-meter-long channel constructed of sheet steel. Water was circulated by a motor-driven propeller pump. Determination of reaeration coefficient by chemical method yielded the following regression equation (expressed in logarithmic form): log k-sub-2 = 0.85 log (V/h) + log 4.74, where V is mean velocity of water (ft/sec), and h is mean depth (ft). The coefficient computed electronically was expressed by the relation log D-sub-L = 0.78 log (V/h) + log 310. The value of log k-sub-2, in turn, was equal to 1.63 log (V/h) + log D-sub-L + log 0.0153. The latter relationship is more accurate and may be used for estimating reaeration coefficient of rivers with velocity not exceeding 1.2 meter/second and the depth less than 0.5 meters. (Wilde-Wisconsin)
W70-07258

CRYSTALLIZATION OF EUTROPHICATION CONCEPTS IN NORTHERN EUROPE,
Uppsala Univ. (Sweden). Inst. of Limnology.
Wilhelm Rodhe.
Eutrophication: Causes, Consequences, Correctives, p 50-64. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 3 fig, 49 ref.

Descriptors: *Eutrophication, *History, Phytoplankton, Oligotrophy, Primary productivity, Ecosystems, Peat, Bogs, Nutrients, Limnology, Oxygen, Distrophy, Hypolimnion, Wisconsin, Organic matter, Carbon radioisotopes, Aging (Biological), Soils, Climatic data, Shape, Oxidation-reduction potential, Phosphates, Mud, Iron, Sulfides, Indicators, Biological communities, Lakes, Classification.
Identifiers: Mixotrophy, Saprobionts, Saprobic, Saprobiensystem, Lake typology, Eutrophication concepts, Trophy, Autotrophy, Allotrophy.

History of ecological classification of lakes, lake typology, trophic classification concepts, and lake evolution are discussed. Naumann chose phytoplankton production where algal production and nutrient level appeared to disagree. Trophy indicates intensity and kind of organic matter supply; autotrophy indicates intensity of its own total organic matter production; allotrophy indicates intensity of organic supply from its environment. Autotrophy is based on the level of primary production of phytoplankton, sessile algae, and higher vegetation combined. Investigations showed that the rate of organic matter production in the photosynthetic layer determines oxygen consumption in the mud-water interfaces and consequent nutrient liberation from sediments. The German terms 'saprobionts' (Saprobien) and 'saprobic' are used for organisms living in water more or less polluted by putrescible organic matter. Shortcomings of Saprobiensystem are due to its dependence on deficient foundations of scientific principles and definitions. Saprobicity indicates total ecosystem respiration and can be measured, at least as to order of magnitude, by metabolic-dynamic methods. These assessments can be combined with qualitative and quantitative determinations of the organism communities. Biomass exchange of autotrophs and heterotrophs can indicate biocenoses structure and saprobicity level, thus establishing connection between trophic concepts and essential aspects of Saprobiensystem. (See also W70-03975). (Jones-Wisconsin)
W70-07267

EUTROPHICATION INDICES AND THEIR RELATION TO OTHER INDICES OF ECOSYSTEM CHANGE,
Michigan Univ., Ann Arbor.
Frank F. Hooper.
Eutrophication: Causes, Consequences, Correctives, p 225-235. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 27 ref.

Descriptors: *Eutrophication, Data collections, Evaluation, Forecasting, Morphometry, Productivity, Nutrients, Dissolved oxygen, Phosphorus, Photosynthesis, Ecosystems.
Identifiers: *Eutrophication indices, Species diversity, Transparency, Species stability.

There are four criteria of a useful eutrophication index: (1) it should discriminate between changes associated with nutrient level and those associated with other categories of environmental change; (2) it should have considerable sensitivity to levels of enrichment; (3) it should have properties which are widespread geographically and short-lived geologically; (4) it should be suitable for long-term surveillance and monitoring. Indices should both document past changes and serve a predictive function. Indices showing greatest promise at present are species diversity, carbon fixation and production-consumption balance. Specific biological indicators are rare; further research on such organisms is needed. Nutrient levels are useful but continuous monitoring is necessary; turnover rates of nutrients, especially phosphorus, may serve as stable indices. Morphometric indices, transparency data and oxygen budgets show less promise due to lack of ubiquity and low sensitivity. All indices used thus far measure processes occurring at all stages of enrichment; they are not specific for normal or cultural eutrophication. To gain specificity, such indices must measure changes over a considerable time span. Acceleration will appear as a change in intensity or rate of process; detection of such accelerations will make possible the differentiation of normal and cultural processes of eutrophication. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07270

BATCH CULTURING OF THERMOPHILIC BENTHIC ALGAE AND PHOSPHORUS UPTAKE IN A LABORATORY STREAM MODEL,
Wisconsin Univ., Milwaukee. Dept. of Botany.
Jon A. Sperling, and Ralph Grunewald.
Limnology and Oceanography, Vol 14, p 944-949, 1969. 4 fig, 8 ref.

Descriptors: *Algae, *Cultures, *Phosphorus, Analytical techniques, Model studies, Streams, Currents (Water), Biomass, Laboratory tests, Thermal water.
Identifiers: *Thermophilic algae, *Phosphorus uptake, Batch cultures, Stream models, Scintillation detector, AEC Analyzer, Southwest Iceland, Hot Springs.

Stimulation in the biomass growth and the uptake of radiophosphates due to increased rate of water flow is described. The study was conducted in an 1- by 2-meter stream model with 2 Plexiglas channels. Mastigocladus laminosus, a thermophilic alga, served as the test organism. Apparatus and methods are described. (Wilde-Wisconsin)
W70-07284

INDUSTRIAL DESIGN STUDY FOR AN AIRBORNE IR MAPPER,
Utah Center for Water Resources Research, Logan.
Donn C. Goode.
Available from the Clearinghouse as PB-192 210, $3.00 in paper copy, $0.65 in microfiche. Utah State University Center for Water Resources Research Report CWRR-14-3, Masters Thesis in Industrial and Technical Education, 1969. 39 p, 14 fig, 1 tab, 7 ref. OWRR Project A-004-UTAH (5).

Descriptors: *Remote sensing, *Infrared radiation, *Mapping, *Instrumentation, Aircraft, Surveys, Terrain analysis, Research and development.
Identifiers: Airborne infrared mapping.

An industrial design and development study was made to create an inexpensive infrared aerial mapping instrument which can be adapted for basic research. The instrument was designed for installation on board a conventional twin engine aircraft and requires minimal modifications. Aerial infrared terrain photographs are produced which are useful in a number of scientific research applications. These photographs are developed using a polaroid film pack which allows in-flight data evaluation. In addition, fine grain film and video tape recording can be used to permit laboratory analysis of data. Mechanical design considerations, operational characteristics, and preliminary laboratory test data are described. (Knapp-USGS)
W70-07330

SPECTRAL INFRA-RED REFLECTION MEASUREMENTS FROM NATURAL AND TREATED ASPEN FORESTS,
Utah Center for Water Resources Research, Logan.
Frank W. Haws, Ralph Briscoe, and Allan Steed.
Available from the Clearinghouse as PB-192 209, $3.00 in paper copy, $0.65 in microfiche. Utah State University Center for Water Resources Research Report CWRR-14-4, December 1969. 17 p, 7 fig, 1 tab, 5 ref. OWRR Project A-004-UTAH (4).

Descriptors: *Remote sensing, *Infrared radiation, *Spectroscopy, *Transpiration control, *Evapotranspiration control, Chemcontrol, Soil moisture, Water yield improvement, Utah, Transpiration, Evapotranspiration, Water conservation, Vegetation effects, Consumptive use.
Identifiers: Aspen trees.

Spectral reflectance measurements were made during the summers of 1967 and 1968 on a natural stand of aspen in Utah, part of which was treated with foliar chemicals. The previous year spectral reflectance measurements were made on individual plants in the laboratory. The stand averages about 55 feet in height on a south-facing slope of about 25 percent and is located in the aspen zone of vegetation of the Wasatch Mountains at an elevation of about 7800 feet. The reflectance from the vegetation due to various environmental changes is highly wavelength dependent. The laboratory measurements showed a definite decrease in infrared reflectance as the soil moisture was depleted. The field measurements in the natural watershed showed a similar reduction in infrared reflectance after a considerable number of days without precipitation. In both the laboratory and the field measurements the infrared reflection loss occurred while the apparent visible reflection remained constant. (Knapp-USGS)
W70-07332

APPLICATION OF SHORT-LIVED COSMOGENIC RADIONUCLIDES AS TRACERS OF IN-CLOUD SCAVENGING PROCESSES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 02B.
W70-07337

MEASUREMENT OF THE VELOCITY OF GAS BUBBLES IN WATER BY A CORRELATION METHOD,
European Atomic Energy Community, Ispra (Italy). Reactor Physics Div.; and European Atomic Energy Community, Ispra (Italy). Heat Transfer Div.
W. Matthes, W. Riebold, and E. De Cooman.
The Review of Scientific Instruments, Vol 41, No 6, p 843-845, June 1970. 3 p, 5 fig, 1 tab, 2 ref.

Descriptors: *Flowmeters, *Bubbles, *Instrumentation, *Flow measurement, *Optical properties, Air entrainment, Aeration, Correlation analysis.
Identifiers: Multiphase flow, Lasers.

An experimental method is suggested for the measurement of the gas bubble velocity in water flow using a correlation method well known in neutron physics. Two laser light beams (L-1, L-2)cross the region of two phase flow and are registered by two photodiodes (F-1, F-2). A bubble crossing L-1 leads to an intensity variation of the light beam due to scattering and refraction and gives rise to an electric pulse in F-1. This pulse triggers a multichannel time analyzer. The pulses from F-2 (due to bubbles crossing L-2) are fed into the time channels and stored corresponding to their time delay relative to the trigger pulse. The change of the bubble velocity is greater in the case of liquid flow rate variation (entrainment effect). The extremely high reproducibility of the cross correlation curves measured is emphasized. (Knapp-USGS)
W70-07356

AUTOMATIC METHODS FOR DETERMINING NITRATE AND NITRITE IN WATER AND SOIL EXTRACTS,
Norsk Institutt for Vannforskning, Blindern; and Norges Landbrukshoegskole, Vollebekk.
For primary bibliographic entry see Field 05A.
W70-07358

REMOTE SENSING ANALYSIS OF WATER QUALITY,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Observation Sciences Dept.
For primary bibliographic entry see Field 05A.
W70-07362

BOREHOLE SEISMICS MULTIPLY DRILL DATA,
Acoustical Minerals Exploration, Inc.
B. B. Brenden, V. I. Neeley, and G. F. Garlick.
Engineering and Mining Journal, Vol 171, No 2, p 93-96, Feb 1970. 4 p, 5 fig.

Descriptors: *Boreholes, *Drill holes, Acoustic equipment, *Borehole geophysics, *Geologic investigations, Geologic control, Geophysics, Subsurface investigations, *Sonic waves, Sonar, Sound waves, *Seismic investigations, Orientation, Joints (Geology), Faults (Geology), Ultrasonics, Sounding, Detectors.
Identifiers: Diamond drilling, Geologic defects, *Echo ranging, Well logging, Geophysical prospecting, *Sonic probes, Seismic reflection.

An accoustical imaging and mapping system was developed specifically for diamond drill holes. The technique is an extrapolation and refinement of sonar and ultrasonic nondestructive testing. When coupled with computer analysis of reflected echoes, the system gives detailed information on fault and vein structure between holes. High-power transducers for generating sound waves and detecting reflected waves are mounted in a probe that can be used in AX and larger size diamond drill holes. The range and resolution for detecting reflecting anomalies depend on several factors; typical values are a range of 25 ft with a resolution of 1 ft, and with modifications, a range of 200 ft with a resolution of about 10 ft. Strike, dip, and vein thickness may be calculated by solving the conventional 3-point problem. Calculations can be simplified by a mechanical device (the geologists' computer) that gives a direct readout of dip and strike. (USBR)
W70-07439

SATELLITE PHOTOGRAPHY FOR SNOW SURVEILLANCE IN WESTERN MOUNTAINS,
Allied Research Associates, Inc., Concord, Mass.
James C. Barnes, and Clinton J. Bowley.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 34-40, 1969. 7 p, 8 fig, 8 ref. ESSA Contract E-196-68.

Descriptors: *Snow surveys, *Snow cover, *Remote sensing, *Satellites (Artificial), *Runoff forecasting, Water management (Applied), Snowpacks, Snowmelt, Snow management, Streamflow forecasting.
Identifiers: Snow cover surveys.

Satellite photography can already provide the hydrologist with useful information concerning snow cover distributions. From existing data, the horizontal distribution of snow can often be mapped as accurately as, or more accurately than, from a typical ground station network. Future mapping, based on higher resolution camera systems, can be expected to be considerably more accurate than from ground stations, especially in remote areas where the reporting network is sparse. With more sophisticated earth-viewing geophysical satellites planned for the coming years, the outlook for operational snow mapping from satellite data is promising. (See also W70-07535). (Knapp-USGS)
W70-07534

HYDROLOGY OF SNOW PROFILES OBTAINED WITH THE PROFILING SNOW GAGE,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02C.
W70-07535

A 2-YEAR EVALUATION OF THE SNOWMELT LYSIMETER,
Forest Service, Moscow, Utah. Forestry Sciences Lab.
Harold F. Haupt.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 97-101, 1969. 5 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Snowmelt, *Lysimeters, Streamflow forecasting, Runoff forecasting, Instrumentation, Water yield, Water supply, Hydrographs.
Identifiers: Snowmelt lysimeter.

A snowmelt lysimeter operation is described, and a history of other snowmelt lysimeters and their operations are reviewed. The lysimeter designed for this study has an area of only 2.72 square feet and appears more adaptable for research operations than earlier lysimeters. A detailed description is presented and illustrated by schematic drawings. The catchment area was sealed off by a polyethylene barrier that guided snowmelt water into a plastic pipe, thence into a 50 gallon barrel receiver with a Stevens Type A-35 stage recorder. Time rates of melting by 1/2; 1; 2; 6; and 24 hourly intervals were recorded for clear, and rain on snow occasions. This snowmelt lysimeter provided direct measurements of melt output during clear weather, as well as rain percolating through the pack plus melt during rainy periods. By following the installation and operation procedures outlined in the report, accurate data can be obtained at relatively low cost. (See also W70-07542). (Knapp-USGS)
W70-07541

7C. Evaluation, Processing and Publication

RECONNAISSANCE OF THE PIGEON RIVER, A COLD-WATER RIVER IN THE NORTHCENTRAL PART OF MICHIGAN'S SOUTHERN PENINSULA,
Geological Survey, Washington, D.C.
G. E. Hendrickson, and C. J. Doonan.
For sale by US Geological Survey, Dept of Interior, Wash, DC -- Price $1.25 per set. US Geological Survey Hydrologic Investigations Atlas HA-333, 2 sheets, 1970. Text, 11 fig, 4 tab, 3 map, 4 ref.

Descriptors: *Water resources, *Recreation, *Rivers, *Michigan, *Sport fishing, Camping, Boating, Streamflow, Water quality, Channel morphology.
Identifiers: Pigeon River (Mich).

The Pigeon River, one of Michigan's outstanding trout streams, the favorite of a large number of anglers who return year after year, is discussed in a 2-sheet hydrological atlas consisting of maps, charts, profiles, graphs, tabulated data, and text. Camping is also popular and is usually, but not always, associated with fishing. Boating is very rare on the Pigeon because of numerous portages around log jams. The Pigeon is located in the north-central part of the southern peninsula of Michigan. Headwaters are a few miles northeast of Gaylord, and the mouth is at Mullet Lake, a few miles northeast of Indian River. Interstate Highway 75 roughly parallels the river about 5 to 10 miles to the west. Exits from this highway at Gaylord, Vanderbilt, Wolverine, and Indian River, provide easy access to the Pigeon. The recreational value of the river depends on the streamflow characteristics, quality of water, and character of stream channel, and bed and banks. The purpose of this atlas is to describe these characteristics, and to show how they relate to recreational uses. Sheet 1 of this atlas presents information on streamflow characteristics and water quality. Sheet 2 describes the physical characteristics of the stream channel, and bed and banks, and shows how these physical characteristics relate to streamflow, water quality, and recreational use. (Knapp-USGS)
W70-07166

DEVELOPMENT OF A FLOOD-FORECASTING SYSTEM FOR THE LATROBE RIVER AT YALLOURN,
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 02E.
W70-07177

DIGITAL SIMULATION METHODS FOR HYDROLOGICAL FORECASTING,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02E.
W70-07181

THE METHOD OF INFLUENCE-FUNCTION DETERMINATION FOR LINEAR RUN-OFF MODELS,
For primary bibliographic entry see Field 02E.
W70-07187

METEOROLOGICAL TABLES FOR DETERMINATION OF PRECIPITABLE WATER, TEMPERATURES, PRESSURES ALOFT FOR A SATURATED PSEUDOADIABATIC ATMOSPHERE - IN THE METRIC SYSTEM,
Texas A and M Univ., College Station. Water Resources Inst.
W. O. Eille, R. J. Powers, and Robert A. Clark.
Available from the Clearinghouse as PB-192 089, $3.00 in paper copy, $0.65 in microfiche. Texas Water Resources Institute Technical Report No 16, Dec. 1968. 30 p, 3 tab, 2 ref. OWRR Project A-002-TEX (8).

Descriptors: *Precipitable water, *Data collections, *Meteorological data, *Precipitation (Atmospheric), Rain, Gases, Water vapor, Clouds, Condensation, Rainfall disposition, Water sources, Water yield.

Tables have been prepared in the Metric system for the determination of precipitable water in a saturated atmosphere with a pseudoadiabatic lapse rate. In addition, tables were prepared from which temperature and pressure also can be determined. These tables have rather wide application in hydrometeorological work.
W70-07228

TECHNIQUES FOR EVALUATING LONG-TERM RESERVOIR YIELDS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 06A.
W70-07234

THE RESPONSE OF THE NORTHEASTERN NEW JERSEY WATER TRANSFER NETWORK TO THE 1962-1966 DROUGHT,
Rutgers - The State Univ., New Brunswick, N. J. Dept. of Geography.
For primary bibliographic entry see Field 06E.
W70-07286

EVALUATION OF NATURAL RIVERS,
Antioch Coll., Yellow Springs, Ohio.
For primary bibliographic entry see Field 06B.
W70-07327

DATA FOR WELLS IN THE DOS PALOS-KETTLEMAN CITY AREA, SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
R. A. LeBlanc.
U S Geological Survey Open-file report, January 21, 1970. 128 p, 2 fig, 56 map, 2 tab, 1 ref.

Descriptors: *Water wells, *California, Depth, Screens, Data collections, Castings, Hydrologic data, Surveys, Aquifers.
Identifiers: San Joaquin Valley (Calif).

The Dos Palos-Kettleman City area is in the west and central part of the San Joaquin Valley, in western Fresno and western Kings Counties, California. Between December 1967 and July 1968, 2,690 wells previously canvassed were field checked for use and horsepower changes, and an additional 1,035 wells were canvassed. Selected data, for water wells with a minimum of depth or chemical information, are tabulated and the locations of these wells are shown on maps. A tabulation of all preempted well numbers assigned by the Geological Survey and cooperating agencies through July 1968 is included. (LeBlanc-USGS)
W70-07360

WATER RESOURCES OF SOUTHERN MARYLAND,
Geological Survey, Washington, D.C.
James M. Weigle, Wayne E. Webb, and Richard A. Gardner.
Available for sale by U S Geological Survey, Dept. of Interior, Washington, D.C. 20242 - $1.75 per set. U.S. Geological Survey Hydrologic Investigations Atlas HA-365, 3 sheets, 1970. Text, 6 fig, 13 map, 4 map, 30 ref.

Descriptors: *Water resources, *Surface-groundwater relationships, *Maryland, Groundwater, Surface waters, Water supply, Water yield, Water quality, Hydrogeology, Hydrologic data, Data collections, Aquifers, Streamflow, Water wells, Low flow, Floods, Runoff, Rainfall-runoff relationships.
Identifiers: *Southern Maryland, Potomac River Basin.

A 3-sheet hydrological atlas consisting of text, small-scale maps, graphs, charts, and tabulated data summarizes the results of a water-resources investigation conducted in southern Maryland during 1966 and 1967. Southern Maryland as used in this report includes Calvert, Charles, and St. Marys Counties. Paritcular consideration is given to the relationship of groundwater to surface water, changes in groundwater conditions in recent years, yields potentially obtainable from wells, sustained yields, streamflow yield, chemical quality of the water, and the likelihood of groundwater contamination by salt water from Chesapeake Bay or estuaries. (Knapp-USGS)
W70-07367

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF THE MISSOURI RIVER ALLUVIUM BETWEEN JEFFERSON CITY AND MIAMI, MISSOURI,
Geological Survey, Washington, D.C.
L. F. Emmett, and H. G. Jeffery.
Report available for sale from U S Geological Survey, Dept. of Interior, Washington, D.C. - Price 50 cents. U S Geological Survey Hydrologic Investigations Atlas HA-340, 1 sheet, 1969. Text, 6 fig, 1 tab, 1 map, 14 ref.

Descriptors: *Water resources, *Surveys, *Aquifers, *Alluvium, *Missouri River, Groundwater basins, Petrography, Water quality, Water chemistry, Water yield, Water sources, Water wells, Geology, Hydrogelolgy, Hydrolgogic data, Groundwater.
Identifiers: *Alluvial deposits, Jefferson City (Mo), Miami (Mo).

This hydrologic atlas describes the thickness, areal extent, and lithology of the alluvial deposits of the Missouri River between Jefferson City and Miami, Missouri, and provides information on the occurrence, availability, use, and chemical quality of the water contained in the alluvial aquifer. Flood-plain widths vary from 1.8 to 6.4 miles and have a total surface area of approximately 285 square miles. The flood plain is underlain by alluvium consisting of clay, silt, sand, and gravel which has been deposited by the river. The sand and gravel in the lower part of the alluvium is saturated with water and forms the alluvial aquifer. The water in this aquifer is in hydraulic connection with the Missouri River. Graphs, tables, illustrations and a hydrologic map (scale 1:125, 000) are included in the Atlas. (Woodard - USGS)
W70-07368

SNOWMELT SIMULATION,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02C.
W70-07536

08. ENGINEERING WORKS

8A. Structures

ASPHALT DIAPHRAGMS FOR DAMS BUILT OF LOCAL MATERIALS.
For primary bibliographic entry see Field 08G.
W70-07422

CALIFORNIA UNDERSEA AQUEDUCT PRERECONNAISSANCE STUDY.
Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Sacramento, Calif.

Bur Reclam Report, Dec 1969. 107 p, 3 fig, 501 ref, append.

Descriptors: Aqueducts, *Preliminary investigations, Water resources development, *Water conveyance, *Water requirements, Ecology, *Water transfer, Marine geology, Costs, Bathymetry, Hydrodynamics, *Pipelines, Aquatic environment, Aquatic life, Construction materials, *Underwater construction, Bibliographies, Oceans, California.
Identifiers: Marine biology, *Offshore structures, *Undersea aqueduct (Collective), *Submarine pipelines, Reconnaissance studies.

The study includes 4 major elements: (1) a preliminary evaluation of potential requirements for import water in Southern California and of potential supplies available for export from Northwestern California; (2) an analysis of the state of knowledge regarding materials and accessories for an undersea aqueduct, the marine environment, construction and maintenance problems, and available information on tides, waves, and currents; (3) determination of what additional research and testing would be required to provide data for a full-scale reconnaissance investigation; and (4) development of a program for such an investigation. A full-scale reconnaissance investigation of the California Undersea Aqueduct would cost about $2,188,000 and would take about 5-1/2 yr. The program would be divided into 2 phases. Phase 1, Basic Research, would require 2 yr for a reliable assessment. Phase 2, Reconnaissance Studies, would extend an additional 3-1/2 yr. Based on rough cost estimates prepared by National Science Engineering Co, and modified by the Bureau of Reclamation, cost of water delivered through an undersea aqueduct could possibly be competitive with the cost of water delivered from other potential sources. Has 501 references. (USBR)
W70-07423

WELL SCREENS AND GRAVEL PACKS,
Water Research Association, Medmenham (England).
A. Hunter Blair.
Groundwater, Vol 8, No 1, p 10-21, Jan-Feb 1970. 12 p, 3 fig, 1 tab, 19 ref.

Descriptors: *Water wells, *Wells, *Well screens, Aquifers, Head loss, Unconsolidated soils, Gravels, Sands, Slots, Installation, Maintenance, Sieve analysis, Particle size, Bibliographies, Groundwater, Fines.
Identifiers: *Gravel packs, Slotted walls, Corrosion resistance, Clogging.

The purpose of well screens and gravel packs is to maintain open access within the aquifer, ensuring that thorough development of the well is not impeded by sand. When a well draws on unconsolidated sands and gravels or friable materials, a screen and pack are essential. Well screen designs should incorporate the following features: (1) minimum entrance velocity, (2) maximum open area of screen, (3) correct design of slots to minimize blockages, (4) slot size that matches aquifer or gravel pack medium, (5) corrosion-resistant screen material, and (6) provision for periodic maintenance. A slot shape offering the maximum open area consistent with strength is a priority. Blockage of screens may be caused by chemical deposition formed by precipitation or corrosion products, and coated screens have been used to inhibit this. Gravel packs should include the following design features: (1) sandfree operation after development, (2) lowest possible resistance to permeation, (3) low entrance velocities, (4) resistance to chemical attack, and (5) efficient service life. Gravel pack design should be guided by standard sieve analysis. (USBR)
W70-07437

SMALL DIAMETER WELLS DRILLED BY JET-PERCUSSION METHOD,
Arizona Univ., Tucson.
W. G. Matlock.
Ground Water, Vol 8, No 1, p 6-9, Jan-Feb 1970. 4 p, 4 fig, 3 ref.

Descriptors: *Water wells, *Wells, *Drilling, *Observation wells, *Jets, Drill holes, Neutron counters, Drilling equipment, Well casings, Alluvium, Arizona.
Identifiers: *Jetting, *Percussion drilling, Probes (Instruments), Neutron moisture probes.

Observation wells and access holes for neutron probe use were drilled by a jet-percussion drill rig in coarse alluvial material near Tucson, Ariz. The method combines jetting action that removes loose materials effectively with the percussion necessary to break up tighter formations and large particles. A unique feature of the equipment is the provision for simultaneously drilling and driving the casing to keep the hole open in loose formations. Washed samples of the material being drilled can be obtained from the recirculating water system. Drilling rates were from 7 to 10 ft per hour, and costs including casing were less than $1.50 per ft. Maximum depth is about 100 ft. The drilling rig and drilling method are described. (USBR)

W70-07438

A METHOD FOR ESTIMATING THE ULTIMATE LOAD CAPACITY OF ARCH DAMS,
Indian Inst. of Science, Bangalore.
K. V. Swaminathan and A. Rajaraman.
Water Power, Vol 22, No 2, p 54-62, Feb 1970. 9 p, 13 fig, 27 ref.

Descriptors: Estimating, *Ultimate loads, *Arch dams, Hinges, Concrete dams, Dams, Dam design, Dam failure, *Structural behavior, Thrust, Loads (Forces), Compressive strength, Structural analysis, Deformation, Stress distribution, Foreign design practices, Cantilevers, Load distribution, Bibliographies, Design tools, Moments, Moment distribution.
Identifiers: *Ultimate strength, Arch action, Plastic hinges, Crushing stength, Compressive stress, Thrust loads, Tolke method, India.

Experimental and theoretical analyses are cited, showing that shell and arch concrete structures may develop hings lines along sections about which adjacent parts rotate under increasing load. A method based on the development of hinge lines for estimating the ultimate load capacity of arch dams is described. The behavior of arch dams loaded by a gradually increasing pressure is divided into 3 stages; a theoretical analysis using a modified form of Tolke's method for the different stages is given. The simple method can be used to estimate the ultimate load capacity of arch dams when the shape of the dam and valley can be idealized. Results obtained using the method agree fairly closely with model test results. (USBR)
W70-07440

THE BACKWATER RESERVOIR WORKS OF THE EAST OF SCOTLAND WATER BOARD.

Water and Water Engineering, Vol 73, No 885, p 449-457, Nov 1969. 9 p, 13 fig.

Descriptors: Water resources, *Earth dams, *Grout curtains, *Grouting, Cutoff walls, Overburden, *Reservoirs, Water storage, Rivers, Reservoir storage, Industrial water, *Faults (Geology), Fissures, Sedimentation, Joints (Geology), Bedrock, Bentonite, Silicates, Spillways, Weir crests, Chemical grouting, Foreign construction, Foreign projects.
Identifiers: *Grout coverage, Great Britain, Scotland.

Backwater Reservoir has a capacity of 5500 million gallons of water and adds 9 million gallons per day to the resources of the East of Scotland Water Board. The reservoir is the first stage of developments planned to add successively further quantities of 6, 12, and 15 million gallons per day to the Board's resources. Backwater Dam is the first major earth dam to be constructed in the United Kingdom where a grouted cutoff curtain through overburden has been constructed. A pattern of holes extended into bedrock was drilled across the valley on the centerline of the dam. Three types of grout were used: silicate, clay cement, and deflocculated bentonite. 550,000 cu ft of grout were injected into the ground. The technique employed could make possible the development of water storage in valleys previously dismissed from serious consideration because of unfavorable or uncertain ground conditions. (USBR)
W70-07442

CHANGES IN NATURAL CHANNELS DOWNSTREAM FROM MAN-MADE RESERVOIRS,
Mississippi State Univ., State College. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-07519

8B. Hydraulics

THE FULLY-MIXED STREAM TEMPERATURE REGIME,
Tennessee Valley Authority, Norris.
For primary bibliographic entry see Field 02E.
W70-07324

FORMATION OF HYDRAULIC JUMPS IN A ROTATING SYSTEM,
Naval Postgraduate School, Monterey, Calif., and Utah Univ., Salt Lake City.
R. T. Williams, and A. M. Hori.
Journal of Geophysical Research, Vol 75, No 15, p 2813-2821, May 20, 1970. 9 p, 9 fig, 13 ref. NSF Grant GA-849.

Descriptors: *Hydraulic jump, *Mathematical studies, *Hydraulics, *Rotational flow, *Hydrodynamics, Froude number, Surges, Turbulent flow.
Identifiers: Rossby number, Rotating fluid systems.

The formation of hydraulic jumps in a rotating, homogeneous, one-layer fluid is investigated. A scale analysis indicates that jump-formation cases should be separated from nonjump cases by a curve in which the Froude number is proportional to the square of the Rossby number. Numerical solutions verify the curve up to $F = 0.33$ and show that the coefficient of proportionality is in the range 6.0-7.5. The solutions for $F = 1.0$ are examined in considerable detail. Jumps can occur in the nonjump region when large evolution times are allowed. This relation has several possible applications in meteorology and oceanography. Internal waves in the ocean are affected by rotation, and the breaking of these waves should be described by the model. Hydraulic jumps may also be important in storm surge prediction. (Knapp-USGS)
W70-07354

POWER INTAKES,
International Power and Engineering Consultants Ltd., Vancouver (British Columbis).
R. E. Johnson, and P. E. Fawkes.
Engineering Journal (Canada), Vol 52, No 10, p. 61-65, Oct 1969. 5 p, 6 fig, 2 ref.

Descriptors: Intake gates, Intakes, *Intake structures, Intake towers, Hydroelectric plants, Powerplants, *Hydraulic models, *Hydraulic design, Hydraulic structures, Model studies, *Model tests, Surges , Mathematical models, Foreign design practices.
Identifiers: Peace River Proj (Canada), Intake channels, *Approach channels, Portage Mountain Powerplant (Canada), Canada.

Hydraulic scale models and a mathematical model used in designing the power intake structures for Portage Mountain Powerplant, located on the Peace River in Canada, are discussed. The structures consist of 10 individual intakes that have free standing gate towers located at the upstream toe of the dam. Seven towers were designed to operate over a 100-ft range of reservoir level and 3 towers were set 110 ft lower to permit early power generation during initial reservoir filling. A 1:70 scale model covering the area upstream from the intakes was used to study the approach channels and the performance of the intakes over the range of operating reservoir levels. A 1:32.2 scale model of a single low-level intake was used to study the hydraulic behavior of the intakes. Surge in the gate shafts was analyzed by using a mathematical model. The model studies resulted in better flow distribution to thelow-level intakes, substantial reductions in excavation in the approach channels, and several improvements in the design of the intake structures. (USBR)
W70-07427

MANIFOLD AND TAILRACE SYSTEM,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
P. W. W. Bell.
Engineering Journal (Canada), Vol 52, No 10, p. 66-70, Oct 1969. 5 p, 7 fig, 1 ref.

Descriptors: *Tailrace, Hydraulics, Hydraulic models, Tunnels, Surges, Hydroelectric plants, Hydroelectric power, Foreign design practices, Foreign construction, Open channel flow, *Hydraulic design, Hydraulic transients, Head loss, *Model studies, Cavitation, Water hammer, Model tests, Optimum design.
Identifiers: Portage Mountain Powerplant (Canada), Canada, *Manifolds, Surge waves, Friction coefficient (Hyd), Analytical method.

The tailrace of the 2270-mw Gordon M Shrum Powerplant in Canada is designed as a free-surface system consisting of 2 rectangular collection manifolds, each discharging through a modified horseshoe tunnel to a transition section where the 2 flows join to feed a common tailrace channel. The analytical and model studies used in optimizing the design of major components of the sytem are discussed. Operating experience with Tunnel No. 1 has confirmed the results of these studies. Several schemes are reviewed for maintaining tailrace manifold water levels above a predetermined elevation during the period between initial operation and that of future construction downstream of the tailrace. This tailwater elevation must be held during the interim period to prevent turbine cavitation and water column separation in the draft tube. (USBR)
W70-07428

BOUNDARY SHEAR STRESS DISTRIBUTION IN RECTANGULAR OPEN CHANNELS,
Calgary Univ. (Alberta).
N. Rajaratnam and D. Muralidhar.
La Houille Blanche, No 6, p 603-609, 1969. 7 p, 13 fig, 1 tab, 18 ref.

Descriptors: Open channels, *Open channel flow, Laboratory tests, Wall friction, *Stress distribution, *Boundary shear, Boundary layers, Froude number, Water surface profiles, *Supercritical flow, Hydraulics, Flumes, Hydraulic models, Bibliographies, Velocity distribution, Turbulent flow, Reynolds number, Foreign research, Skin friction.
Identifiers: *Rectangular channels, Bed shear, Aspect ratio, Canada.

Hydraulic laboratory experiments were conducted to determine measurements of the shear stress distribution at supercritical velocity in smooth rectangular channels. Maximum stresses on the bed and sides were correlated with the results of the boundary layer theory. A relation was obtained connecting the maximum wall shear stress with the bed shear stress in an infinitely wide channel, and the boundary layers on the bed and sides were studied regarding the velocity distribution. Some interesting results were obtained regarding the velocity dip at the free surface and the discharge distribution. The Froude number of the flows varied from about 1.1 to about 2.4. In the entire range of Froude numbers studied, no perceptible formation of roll waves occurred. (USBR)
W70-07441

8C. Hydraulic Machinery

NO-ELECTRODE MHD HAS AC OUTPUT.

Electrical World, Vol. 173, No. 21, May 25, 1970. p 23, 1 fig.

Descriptors: *Alternating current, *Electrode, Powerplants, Electric power production.
Identifiers: *Whittaker design, *Magnetohydrodynamic Power generation, Runaway electron, Plasma seeding, Ring current.

Physicists have devised a new method of magnetohydrodynamic power generation. The new system, called the Whittaker design, differs greatly from the old MHD generating system. This new technique involves the pumping of a fuel-air mixture into the combustion chamber at atmospheric pressure where it is ignited to produce a gas at high temperature and pressure. The gas explodes through a nozzle into the low-pressure generator channel, resulting in a 'runaway electron' condition in which conductivity of the plasma is unusually high. The high-velocity plasma interacts with a magnetic field within the generator to produce a strong ring current. By rising and falling with each explosion, the generated current can be connected to an external load through transformer wirings. Special advantages are that there is no need for electrodes in the extraction of electrical energy and that high-voltage current is produced, thus eliminating dc-to-ac power inversion. (Green-Vanderbilt)
W70-07319

ELECTRICAL FEATURES OF THE PRTAGE MOUNTAIN DEVELOPMENT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
R. D. Handel, F. Langenek, and E. D. Mackie.
Engineering Jornal (Canada), Vol 52, No. 10, p. 88-98, Oct 1969. 11 p, 10 fig, 6 ref.

Descriptors: *Hydroelectric plants, Underground powerplants, Control, *Switchyards (Electrical), Bus (Electrical), Foreign construction, Fire alarm systems, *Electric generators, *Power transformers, Methane, Fire safety, Supervisory control (Power), Governors, Data collection systems, Excitation, Recording systems.
Identifiers: *Control equipment, *Protection (Electrical), Portage Mountain Powerplant (Canada), Canada, Peace River Proj. (Canada).

The Portage Mountain Development has an ultimate installed capacity of 2270 mw generated by 10 underground units. The station layout and major electrical equipment are described. A 500-kv switchyard supplies two 500-kv transmission lines to the Vancouver area, and a 138-kv switchyard supplies local load centers. The 138-kv switchyard contains breaking resistors applied during system disturbances to control accelerating power levels. The station features forced-cooled isolated phase buses connecting the underground powerhouse and the surface switchyard and rigid aluminum tubular buswork in the 500- and 138-kv switchyards. Details of station control methods are presented. The control and metering systems are largely selective, giving a compact central control facility. The operator is assisted by a digital data logger system, a solid-state event recorder, and automatic fault recorders. The generators employ electrohydraulic governing and static excitation. Joint VAR/VOLT control of the exciters and joint WATT control of the governors are supplied. The 500-kv transmission lines are protected by duplicate static distance relays using microwave and powerline carrier channels. (USBR)
W70-07429

HEATING AND VENTILATING OF UNDERGROUND AREAS,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
N. Purssell, and M. N. Bakshi.
Engineering Journal (Canada), Vol 52, No 10, p 109-116, Oct 1969. 8 p, 3 fig, 12 ref.

Descriptors: *Heating, *Ventilation, *Cooling, design, Hazards, Shafts (Excavations), Air conditioning, *Underground powerplants, Construction, Tunnels, Foreign construction, Methane, Explosions, Powerhouses, Cold regions, Hydroelectric plants.
Identifiers: *Portage Mountain Powerplant (Canada), Peace River Proj (Canada), Canada.

The powerplant at Portage Mountain Development, Canada, located 500 ft underground, contains 3 million cu ft of space and 3 mi of tunnels. The article describes overall heating and ventilating design considerations, including methods for dilution and removal of methane gas and heating and ventilating during construction. Construction ventilation is normally the responsibility of the construction contractor, but for reasons of scheduling and because of the explosive gas hazard, a basic ventilating system was designed and partially installed before awarding the powerhouse construction contract. After construction of the generator hall, tunnels, and shafts, heating and ventilating was a problem because of the year-round rock temperature of about 40 deg F; after complete installation of generating units, cooling will be the problem. (USBR)
W70-07430

BUREAU OF RECLAMATION PUMPED STORAGE PLANTS,
Bureau of Reclamation, Denver, Colo.
Carlos G. Bates.
Paper at Amer Soc Civ Eng Nat Meet Water Resour Eng, Memphis, Tenn, Jan 1970. 24 p, 6 fig, 2 tab, append.

Descriptors: *Pumped storage, *Pump turbines, Hydraulic turbines, Hydroelectric power, *Electric power production, Maintenance, Pumps, Design, *Models, Valves, Peak power, Peaking capacities, Operations, Irrigation.
Identifiers: *Wicket gates, San Luis Pumping-Generating, O'Neill Pumping Plant, Calif, Bureau of Reclamation, Flatiron Powerplant, Colo.

The primary purpose of pump-turbine units is 2-way water handling to facilitate meeting irrigation water demands. The power produced is a bonus to the systems. The Bureau of Reclamation has 21 reversible pump-turbine units operating in 4 plants. Four additional units to be installed in 2 plants are in the design stage. The 4 operating pumped storage plants and the 2 plants being designed are discussed. When power system emergencies occur, rapid reversal from pumping to generating within a few seconds is an asset to the system. Pump-turbine design, operation, and maintenance considerations are given. Use of wicket gates or discharge valves depends on the needs of individual plant and power systems. Bureau startup problems have been minimal. Experience shows that majoration between model and prototype can be greater than the manufacturer anticipates. (USBR)
W70-07432

NEW LAW FOR LIQUIDS: DON'T SNAP, STRETCH,
National Engineering Lab., East Kilbride (Scotland).
Alan T. J. Hayward.
New Scientist, Vol 45, No 686, p 196-199, Jan 1970. 4 p, 5 fig.

Descriptors: *Cavitation, Trees, *Nucleation, Atmospheric pressure, Foreign research, Cohesion, Tensile strength, Tension, *Negative pressure, Bubbles, *Water properties, *Pumps, Hydraulic machinery, Fluid mechanics, Hydraulics, Liquids.
Identifiers: Cavitation control, Cavitation parameters, Cohesive strength, Great Britain, *Tensile properties, *Suction.

Trees can raise water to heights of 100 ft and more, but mechanical pumps can lift water no higher than 34 ft--the height the atmosphere will support a column of water. Nature utilizes the tensile strength of liquids to draw water to great heights. Water has a relatively high tensile strength capable of withstanding a tension of -300 atm. Pumps fail to lift water higher because of cavitation. Cavitation bubbles form under negative pressures from undissolved gas nuclei, from the breakup of other bubbles, and from cavities nucleated between rubbing surfaces. Undissolved gas nuclei normally are present in natural and distilled water, and are stable at atmospheric pressure for indefinite periods; however, water can be denucleated by applying high pressure and forcing the gas nuclei into solution. If man is to follow nature's example and design hydraulic machinery to operate under negative pressures without cavitation, the water must be denucleated and the cavitation-producing conditions avoided. By meeting these requirements, a suction pump was built that can lift water to a height of 56 ft under a negative pressure of -1 atm. (USBR)
W70-07434

THE ESCLANGON DIAGRAM FOR VOLTAGE AND CURRENT ALONG A TRANSMISSION LINE,
Institut Polytechnique, Grenoble (France).
Michel Polou jadoff.
Inst. Elec. Electron Eng. Spectrum, Vol 7, No 2, p 92-94, Feb 1970. 3 p, 6 fig, 6 ref.

Descriptors: *Transmission lines, *Graphical analysis, *Operations, Transmission (Electrical), Losses, Electric potential, Electric currents, Electrical impedance, Wavelengths, Foreign research.
Identifiers: Esclangon diagram, Transmission losses, France.

Graphic representations of abstract ideas and concepts are not discovered often. The Esclangon diagram, showing the variation of current and voltage along a transmission line for a steady sinusoidal operation, is given. Although the diagram does not replace other methods for solving transmission line problems, it is an efficient way of showing such variations, and provides a graphic technique that enhances considerably the art of transmission line operation. The method complements the Smith chart and the usage of basic formulas for a proper understanding of transmission line problems. (USBR)
W70-07443

8E. Rock Mechanics and Geology

DETERMINATION OF IN SITU STRESSES FOR THE UNDERGROUND PUMPING CHAMBER OF SOUTHERN NEVADA PUMPING PLANT NO 1,
Bureau of Reclamation, Denver, Colo.
G. L. Butler.
Bur Reclam Report REC-OCE-70-4, Jan 1970. 20 p, 16 fig, 8 tab.

Descriptors: Pumping plants, *Stress relieving, Stress analysis, Core drilling, Field tests, Structural behavior, *Underground structures, Stress distribution, Rock foundations, Boreholes, Drill holes, Strain measurement, *Rock mechanics.
Identifiers: Southern Nevada Pumping Plant No 1, In situ tests, *Borehole deformation gage, *Overcoring method.

The borehole stress relief method was used to determine the in situ stress in the rock mass surrounding the underground pumping chamber for Southern Nevada Pumping Plant No 1. A 3-directional borehole gage was used to measure the deformation of 1-1/2-in.-dia boreholes overcored with 6-in. drill bits to relieve stress. Three 25-ft boreholes having different orientation were drilled so that a 3-dimensional stress field could be computed. The stress field was determined at one location within the pumping chamber after excavation was completed, to check estimated values used in designing the chamber with available geological data. (USBR)
W70-07433

8F. Concrete

THE BACKWATER RESERVOIR WORKS OF THE EAST OF SCOTLAND WATER BOARD.
For primary bibliographic entry see Field 08A.
W70-07442

8G. Materials

ASPHALT DIAPHRAGMS FOR DAMS BUILT OF LOCAL MATERIALS.

Transl from Gidrotekh Stroit, No 11, p. 15-18, 1969. Bur Reclam Transl 835, Mar 1970, 11 p, 4 fig, 1 tab, 22 ref.

Descriptors: *Asphaltic concrete, Asphalt, *Diaphragms, Dams, Foreign design practices, Dam construction, Dam design, *Earth dams, Impervious membranes, Cold weather construction, *Rockfill dams, Bibliographies, Reliability, Maintenance, Cold regions.
Identifiers: Impervious layers, USSR, Electric heating, Asphaltic bitumens, *Poured asphalt, Asphalt membranes.

The expansion of hydrotechnical construction into regions of rigorous climate necessitates developing new means of leakage prevention in dams built with local materials. A method of constructing an internal vertical diaphragm of asphaltic concrete for the water barrier in earth or rockfill dams is described. The method includes using poured asphaltic concrete for the main body of the impervious layer, placed without compaction directly in a casing. To assure impermeability, a vertical interlayer of asphalt slurry can be constructed along the axis of the diaphragm by pouring hot asphaltic slurry into a vertical movable form. Electric heating of the slurry layer may be necessary in a particularly cold climate. Heating is necessary only for repair purposes following the appearance of leakage through the diaphragm. The interlayer of asphalt slurry and heating are not necessary in milder climates. Construction of such diaphragms is fairly simple and is independent of climatical conditions. Several examples of dams having diaphragm water barriers are cited, and some advantages and disadvantages of different types of diaphragms are discussed. Has 22 references. (USBR)
W70-07422

THE BACKWATER RESERVOIR WORKS OF THE EAST OF SCOTLAND WATER BOARD.
For primary bibliographic entry see Field 08A.
W70-07442

8H. Rapid Excavation

DIFFUSION BLASTING AND ITS POTENTIAL FOR THE DEVELOPMENT OF AUSTRALIA'S INLAND SURFACE WATER RESOURCES,
T. D. J. Leech.
Journal of the Institution of Engineers (Australia), Vol 41, No 10-11, p 165-173, Oct-Nov 1969. 9 p, 12 fig, 46 ref, 1 tab, 2 append.

Descriptors: Blasts, *Explosives, *Nuclear explosions, *Craters, Water loss, *Cratering, *Water storage, Water resources development, Radiation hazards, Thermal radiation, Costs, Cost comparisons, Seismic waves, Foreign research, Underground water storage, Bibliographies, Water resources, Underground explosions, *Reservoir construction, *Reservoirs.
Identifiers: Blasting, *Explosive construction, *Explosive excavation, *Nuclear excavation, Nuclear effects, Rapid excavation, Australia.

In Australia, little more than 2% of the total average discharge of rivers is being used effectively, but there are proposals to double the quantity of water stored during the next 2 decades. Then the availability of sites suitable for economic development of convetional storages will become limited. Use of chemical and nuclear explosives to blast craters for water storage is suggested. Principles of diffusion blasting and their applications to water resource development are reviewed. Cratering, use of multiple charges, and effects of air blast, thermal radiation, seismic waves, and radioactivity are discussed. Diffusion blasting is an attractive approach to water storage because unit costs are low, evaporation rates from craters are negligible, and seepage rates in many media are lowered by blasting. Layouts of a storage system consisting of multiple craters and a system consisting of a single crater are presented. A cost breakdown is given for a basic single crater system produced by a single one-megaton explosion that would result in a storage capacity of about 60,000 acre-ft. Gross capital cost for the system would be about $40 per acre-ft. A comparison of unit costs between conventional and crater storage is given.
W70-07431

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WATER-RESOURCES MANPOWER--SUPPLY AND DEMAND PATTERNS TO 1980.
Louisiana Water Resources Research Inst., Baton Rouge.
James E. Lewis.
Available from the Clearinghouse as PB-192 090, $3.00 in paper copy, $0.65 in microfiche. Louisiana Water Resources Research Institute Bulletin 4, May 19, 1970. 48 p, 5 fig, 21 tab, 26 ref. OWRR Project A-015-LA (2).

Descriptors: *Manpower, *Professional personnel, *Scientific personnel, Occupations, Human resources, Labor supply, Labor mobility, Specialization, Training.

This study focuses on the question: Can the United States satisfy the demand for water-resources manpower in the coming decade. The supply of scientific manpower supply and demand are disaggregated to yield supply and demand projections for water-resources manpower. This supply-engineers, natural scientists, and social scientists--is projected at 3.3 million for 1980; the demand, at 3.5 million. Supply and demand relationships for 1970-1980 decade show a 10-percent deficit of engineers, a 5-percent surplus of natural scientists, and a 7 to 8 percent deficit of social scientists. The supply of water-resources manpower is projected to reach 154,000 by 1980, with about 55,000 persons engaged in research. The 1980 demand for workers in the same field is projected at 267,000, with 95,000 needed in research. Critical manpower shortages are forecast in several disciplines: ecology, hydrology, water-resources planning and management, water quality, and watershed management.
W70-07229

9D. Grants, Contracts, and Research Act Allotments

RESEARCH DEVELOPMENT AND DEMONSTRATION PROJECTS, Division of Applied Science and Technology.
Federal Water Quality Administration, Washington, D.C.
For primary bibliographic entry see Field 5G.
W70-07230

10. SCIENTIFIC AND TECHNICAL INFORMATION

A BIBLIOGRAPHY OF BOOKS ON THE ENVIRONMENT -- AIR, WATER AND SOLID WASTES,
Toledo Univ., Ohio. Dept. of Chemical Engineering.
Gary F. Bennett, and James W. Hostman.
Toledo University Research Foundation Report, June 1969. 52 p, 564 ref.
Descriptors: *Bibliographies, *Environmental sanitation, *Pollution abatement, Environment, Environmental engineering, Waste treatment, Water pollution control, Air pollution, Water quality, Water chemistry, Water treatment, Biochemistry, Hydrology, Water resources, Waste disposal.

This bibliography of 564 references on environmental pollution and sanitation lists technical and nontechnical books as well as journals and conference proceedings. The topics listed include waste water treatment, water chemistry and treatment, biochemical engineering, microbiology, hydrology, water resources, air pollution, solid waste, and related subjects. (Knapp-USGS)
W70-07190

AQUATIC BIOLOGY ABSTRACTS, 1969.
CCM Information Corporation, 909 3rd avenue, New York, N.Y. 10022.

Descriptors: *Abstracts, *Bibliographies, *Aquatic life, *Publications, *Biological communities, Ecology, Environment, Aquatic environment, Aquatic habitats, Aquatic animals, Aquatic plants, Aquatic microorganisms.
Identifiers: Aquatic biology.

Aquatic biology abstracts is a monthly publication with an author index and a separate annual author and subject index. The abstracts are in English, but are prepared from original articles appearing in more than fifteen foreign languages. The publication is under the direction of Information Retrieval Limited of London. The journal literature in the field of aquatic biology is screened and abstracted by professional personnel, and abstracts of new patents for thirty-two countries are included as appropriate. Full bibliographic information is shown with each abstract, including author addresses. Papers of pertinence appear in Aquatic biology abstracts within three months of publication. Approximately 7000 abstracts are indexed annually. (Knapp-USGS)
W70-07370

INTERNATIONAL GLOSSARY OF HYDROLOGY - SECOND DRAFT (JULY 1969).

World Meteorological Organization and United Nations Educational, Scientific and Cultural Organization Report, 1969. 138 p.

Descriptors: *Documentation, *Translations, *Hydrology, *International hydrological decade.
Identifiers: *International Glossary of Hydrology.

A second draft is presented of the International Glossary of Hydrology. It contains 1065 equivalent terms in English, Russian, French, and Spanish, but no definitions. The terms are entered alphabetically, with the English equivalent first in each entry. Alphabetical indexes in French, Russian, and Spanish list the terms and entry numbers in the list of equivalent terms. (Knapp-USGS)
W70-07403

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